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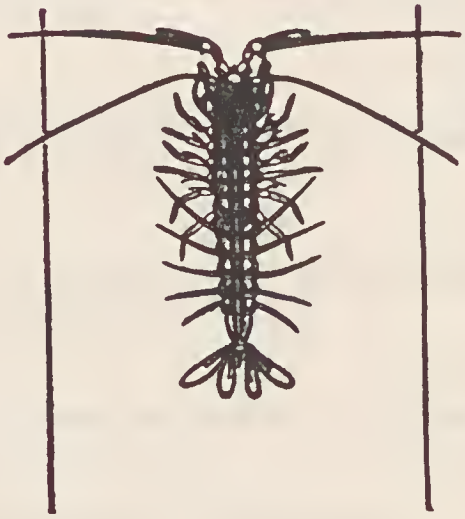

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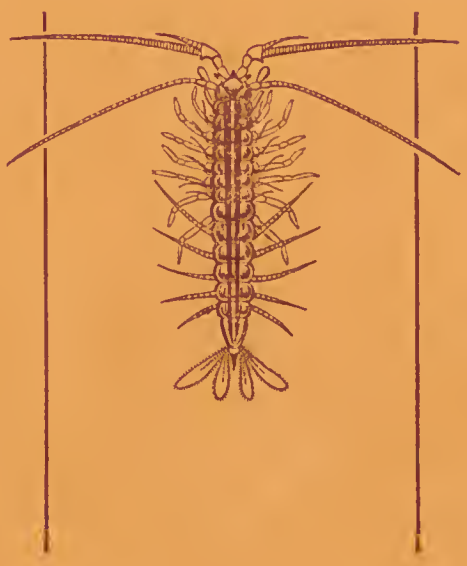
RECORDS OF THE QUEEN VICTORIA MUSEUM LAUNCESTON



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No. 21

RECORDS OF THE QUEEN VICTORIA MUSEUM

LAUNCESTON

FLORA OF THE NUT

WITH BRIEF ACCOUNT OF BOTANICAL INVESTIGATION IN THE CIRCULAR HEAD DISTRICT

by

J. H. WILLIS

Royal Botanic Gardens and
National Herbarium of Victoria.

Manuscript received 14/5/1965
Published 26/3/66

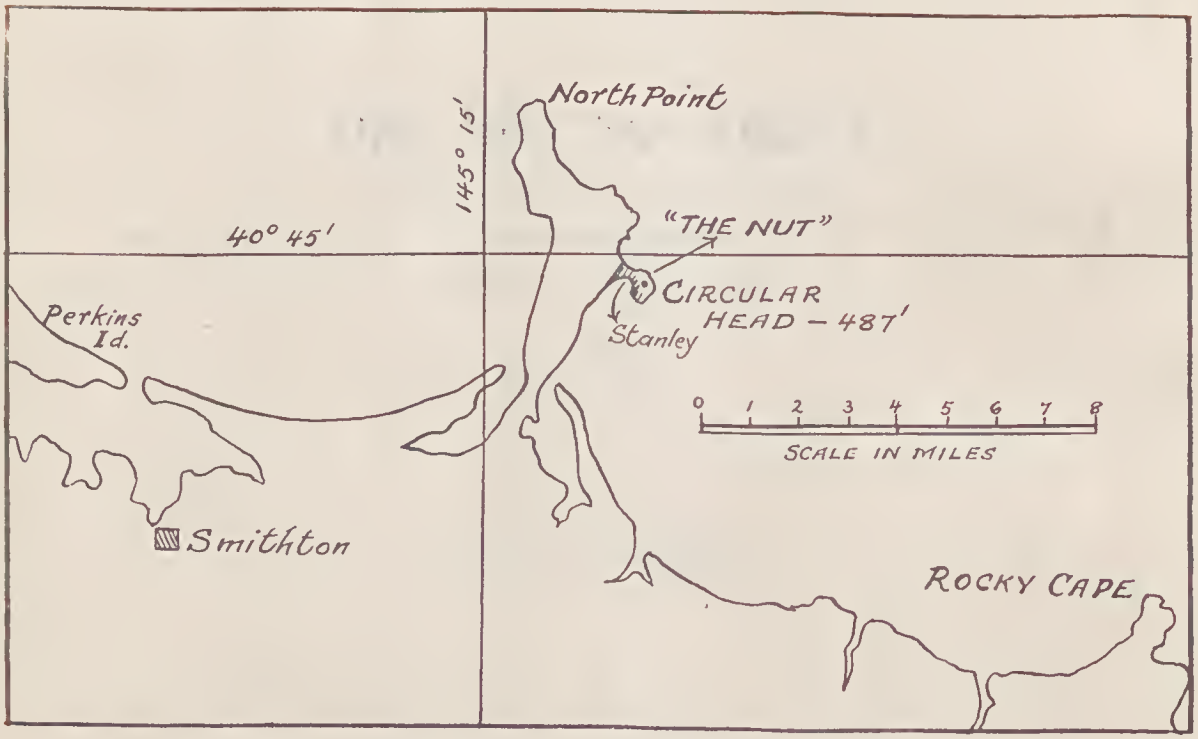

Figure 1. LOCALITY MAP.

HISTORICAL AND GEOLOGICAL NOTES

Captain Matthew Flinders, in company with George Bass, discovered and named Circular Head on 5 December 1798, during their noteworthy circumnavigation of Van Diemen's Land (Tasmania) by the sloop Norfolk. Other conspicuous Tasmanian landmarks named by them in this region were Table Cape, Rocky Cape, Three Hummock Island, Trefoil Island and Cape Grim. Flinders (1814) thus described Circular Head bluff, which is now generally called The Nut:

"a cliffy lump, much resembling in form a Christmas cake, joined to the main by a sandy isthmus".

The *Hobart Town Almanack* for 1831 referred to it as "that curious rock (which) stands like a huge round tower or fortress, built by human hands", while naval surveyor J. Lort Stokes (1846) calls it "a singular cliffy mass of trappean rock, rising abruptly from the water till its flattened crest reaches an elevation of 490 feet." The Nut is certainly one of the most prominent and dramatic features of the coastline in northern Tasmania, if not in the whole Commonwealth.

Edward Curr, the very energetic chief agent of the young Van Diemen's Land Company (formed in May 1824), reached Hobart from England on 4 March 1826, and soon afterwards he chose Circular Head as the Company's chief establishment. On October 24th, the first party of settlers arrived there by the Company's chartered vessel Tranmere and by 1831 Curr had erected a homestead at "Highfield" — a basaltic upland situated at the north-west extremity of Godfrey's Beach, about 1 mile from The Nut.

The first recorded ascent of this imposing bluff was by Stephen Adey at the end of June 1826. Adey was Superintendent of Farms and Stock for the V.D.L. Company's land grants in N.W. Tasmania whither he had gone exploring on foot from the Forth River with Alexander Goldie, the Agricultural Advisor to the Company. In Adey's words, Circular Head consisted of "a stupendous rock of granite, whose area is upwards of 40 acres with good soil on the top and whose height is 6 or 700 feet". Obviously Adey was no geologist, and his estimates of both area and height are wide of the mark. All subsequent observers have recognised the volcanic nature of Circular Head, but it was left to W. T. Twelvetrees, Government Geologist of Tasmania, in consultation with Professor Rosenbusch (1903) to investigate the rock-mass petrologically; they found its alkali percentage (6-8%) twice that of ordinary basalt. Twelvetrees (1903) made no comment on the character of the effusion or course of physiographic events leading to the present configuration of The Nut. T. Stephens (1908), in discussing the geology of the North-West Coast of Tasmania, assembled his "old notes, with a few supplementary observations", but he also was silent regarding the genesis of The Nut.

A. B. Edwards (1941), expounding his belief that The Nut was an exposed and eroded laccolith, went deeper into its petrology and referred the rock to columnar analcite-olivine-dolerite; in an earlier paper (1941) he had also assigned Table Cape and Mt. Cameron West to laccoliths of similar composition. E. D. Gill and M. R. Banks (1956) disputed Edwards's postulation, expressing the opinion that The Nut is basaltic and a remnant of a volcanic neck intruded through tuffs, whereas Mt. Cameron West "is simply a thick flow or series of flows" of basalt.

Commander Stokes (1846) had measured The Nut's maximum height as 485 ft. Dr. Edwards (1941, pp. 247, 249) gave a figure of 460 ft., but in his later paper (p. 403) the height is changed to 487 ft. which is much closer to Stokes's original estimate. Edwards described the shape as approximately circular and the diameter as between 800 and 900 yards. Actually, the summit plateau is broadly elliptical, with a maximum longer diameter of 900 yds. but a shorter one of only 600 yds.; it contains an area of 180 acres.

Small steeply sloping screes fringe the northern and eastern bases where sheer cliffs rise 400 ft. above the open ocean, while on the landward southern and south-western sides the scree-slopes are gentler and higher — up to about one third of the total height. Two shallow valleys, east and south sloping, combine to form a hanging valley that empties toward the south-eastern side over a lip some 160 ft. lower than the highest sector at the north-west. The rainfall averages about 36½ ins., and is concentrated during winter months.

The Nut is now owned by the Federal Government, and is supervised by the Postmaster-General's Department which leases it for grazing purposes.

VEGETATION, PAST AND PRESENT

The writer's interest in plants that grow on The Nut was first aroused when, residing at Stanley as a boy (1920-24), one of his favourite recreations was to climb its escarpments or explore the boulder-strewn base. A collection of local grasses was also made at the request of his schoolmaster. After an absence of more than 40 years, he returned late in January 1965 and was able to carry out a survey of the species now represented — both indigenous and introduced. A few small seasonal plants, and perhaps some rarities, may have been missed at the height of summer, but the accompanying census is believed to be fairly complete for vascular species. A deterioration in the communities of native plants during the past four decades is apparent, the factors chiefly responsible being: sheep and rabbits (grazing both on the landward slopes and upon the crest), encroachment of aggressive weeds (especially gorse), and occasional fires*.Despite these destructive agencies, at least 100 indigenous species of flowering plants and ferns manage to survive on The Nut, all being of wide distribution in other parts of Tasmania and all ranging to southern Victoria.

The very similar, but rather higher, Table Cape near Wynyard still supports a considerable area of eucalypt forest. James Backhouse (1843), who saw this bluff in a state of nature, gave the following description of it on 14 November 1832:

pp. 110-111 —

> "After ascending to the top of Table Cape, we passed over some rich, red loam, clothed with luxuriant vegetation. Fern, Prickly Acacia, and Musky Aster were so thick as to be passed with difficulty. Tree-ferns were numerous, and many lofty shrubs were overrun with Macquarie Harbour Vine and White Clematis. Above the shrubs, rose stately Stringybarks and White Gums, attaining to about 200 feet in height. Here and there, a tree had fallen across the path, which was but indistinctly traced in places, and when left was not easy to find again."

* The last major conflagration was in 1961.

It seemed reasonable to assume that the climax vegetation on The Nut — now virtually treeless — would also have been forestal at the time of white man's appearance; but probably, from its more exposed situation, the eucalypts were somewhat sparser and not so tall as on Table Cape which abuts against fertile inland flows of basalt. A search was therefore made for any early references to the original flora at Circular Head. The earliest glimpse comes from Ida Lee (1927) who published Mrs. Rosalie Hare's account of the voyage of the *Caroline*, written just a century before. Mrs. Hare landed from the *Caroline* at the site of Stanley on 20 January 1828, and thus describes The Nut:

p. 33 —

"The Head, justly called Circular, presented a rather desolate sight. Here were plenty of trees, but they were of Stringey-Bark, so called from their bark continually falling off and hanging in strings."

p. 35 —

"The height of Circular Head appears about four hundred feet. I ascended it in company with the surgeon without much difficulty. We found sheep grazing on its summit and kangaroo leaping about in all directions."

Much more space is devoted to the aborigines observed by Mrs. Hare during her stay of about six weeks at Circular Head; but it is interesting to note that sheep were competing with kangaroos for native pasture on the summit only 15 months after the initial settlement. Kangaroos have long since vanished from this district, but plenty of sheep continue to browse over The Nut at the present time. The Stringybark trees would undoubtedly have been *Eucalyptus obliqua* (Messmate Stringybark) which has also disappeared from Stanley Peninsula, although it is a dominant tree in forest land to the south and still grows on the Table Cape headland. Records of the V.D.L. Company disclose that by 1831 (four years after settlement began) there were saw-pits, yards for sheep and cattle, almost 12 miles of post and three-rail fencing and also some chock-and-log fences at Circular Head. It is highly probable that much of this timber came from the forested lower slopes of The Nut, which were simultaneously put to use as grazing land for stock.

In the Archives Section of the Tasmanian State Library are two old photographs of The Nut, made about 1858. These show scattered living trees around the summit, while numerous taller dead trees and bleached fallen trunks dot the scree slopes above Stanley village — pathetic relics of the stringybark forest seen by Mrs. Hare 30 years before. In *Baillière's Tasmanian Gazetteer* for 1877 by R. P. Whitworth (p. 39) it is stated, concerning The Nut, that "on the summit are several acres of good land covered with timber". There is a strong local tradition that trees were once felled on the top and their trunks rolled down the slopes for firewood for the townsfolk.

Not a vestige now remains even of old tree stumps on the weathered screes near the township, nor on the flattened summit area which at one time was utilised for crops of potatoes — sledged down the gentler inclines at no little difficulty. Along the western and north-western scarps a few windswept, very depauperate examples of *Eucalyptus viminalis* (Manna Gum) persist in the form of unhealthy regrowth from burn-out trunks; these miserable thickets may constitute a remnant of the eucalypt woodland formerly covering the plateau. Equally stunted are the survivals of *Acacia melanoxylon* (Blackwood) along the southern slopes. Four other kinds of small trees, *Banksia marginata*, *Bursaria spinosa*, *Pomaderris apetala* and *Melaleuca ericifolia*, still flourish on the sides of The Nut in fair quantity, vigorous old specimens even clinging to crannies on the exposed northern rock-walls above the sea. Trunks of *Bursaria* frequently assume a picturesque, almost horizontal posture in response to the strong prevailing winds. Conspicuous among the present larger shrubs are *Rhagodia baccata*, *Correa alba*, *Styphelia parviflora*, *Myoporum insulare* (against the sea), *Goodenia ovata* and *Olearia phlogopappa*, while the tall perennial groundsel *Senecio lincarifolius* is locally frequent in sheltered gulches. A single large bush in a steep ravine on the N.E. declivity has been tentatively identified as *Olearia argophylla* — by ocular inspection from some distance. Scattered old shrubs of the attractive coastal Crimson-berry (*Styphelia oxycedrus*) occupy crevices on the more precipitous northern and southern cliffs, but few seedlings are in evidence.

Some plants characteristic of coastal dunes and ocean cliffs form a lower selvage to the steep north and west faces of The Nut, viz *Distichlis distichophylla*, *Stipa teretifolia*, *Lepidosperma gladiatum*, *Carpobrotus rossii*, *Apium prostratum*, *Alyxia buxifolia* and *Sonchus megalocarpus*, only the *Alyxia* (Sea-box) being a shrub. Strangely enough, *Calocephalus brownii* (Cushion-bush) is absent, although it inhabits basalt cliffs at "Highfield" only 1-2 miles to the north-west. Singular also is the apparent absence of *Muehlenbeckia adpressa* (Macquarie Vine) which Backhouse noted as so rank at Table Cape in 1832.

Indigenous herbs have been largely replaced by introductions, e.g. numerous grasses, clovers and thistles. Tussock-forming *Lomandra longifolia* (Sagg) and *Diplarrena moraea* (White Iris), however, are still abundant over the plateau, the latter competing successfully with alien grasses. No species of orchid has been recorded from The Nut, but the family is never well represented on basaltic terrain in southern Australia. One decorative herbaceous perennial, *Helipterum albicans* var. *incanum* (Hoary Sunray), formerly grew in quantity on ledges and in rock crevices overlooking Stanley township whence it has virtually disappeared through picking, for the sake of its large pink and white, papery flower-heads; a few colonies survive on more inaccessible cliff-tops of the northern and eastern sectors. Other perching herbs of cliffs and ledges are *Luzula campestris*, the lilies *Bulbine bulbosa* and *B. semibarbata*, *Scleranthus biflorus*, *Crassula sieberiana* (abundant), *Pelargonium australe* (scattered).

Bryophytes are a conspicuous part of the ground flora, on rock-faces and damp or shaded earth. Thirty five species were noted by the writer in January 1965 and their names are appended, but the list is by no means complete since a number of minute ephemeral mosses would not be in evidence at that season. Probably the commonest moss is *Lembophyllum clandestinum* which covers boulders and walls of rock along much of the townward slopes. The cosmopolitan tufted species, *Ceratodon purpureus* and *Weissia controversa*, are also very frequent on earth or rock. The odorous hepatic, *Plagiochila fasciculata*, was noted only under low shrubberies above a steep scree near the old breakwater (N.E. sector), but *Frullania falciloba* is as common as *Lembophyllum* on rock surfaces where

its closely appressed, flattened ramifications impart a reddish-purple tinge. Lichens are also plentiful—on rock, soil and dead wood everywhere. However, only a dozen species of the larger and more easily recognisable kinds were collected and identified. No attempt was made to list the fungi at such a very unfavourable season.

FERN FLORA

Thirteen species of ferns are present on The Nut, but only two are at all widespread or frequent: ubiquitous Bracken *(Pteridium esculentum)* and Kangaroo Fern *(Microsorium diversifolium)* in rock-fissures and on damp shaded walls. Four species — all of rare occurrence — are restricted to a wet gully-head that drains the hanging valley at the S.E. edge of the scarp (between the old and newer wharves). Here good shelter is afforded the permanent spring by thickets of *Melaleuca, Bursaria* and *Pomaderris;* two small specimens of Soft Tree-fern (*Dicksonia antarctica)* are present, also the Hard Water-fern *(Blechnum procerum).* Overlooking the sea, and often drenched with salt spray, on the northern face are some impressive colonies of the very leathery Shore Spleenwort *(Asplenium obtusatum);* but probably the most surprising occurrence on scarps in this vicinity is Gipsy Fern *(Ctenopteris heterophylla),* a species customarily favouring mossy trunks and branches in very shaded fern gullies. *Blechnum minus* was observed only on the earthen walls of a small deep dam excavated near the summit, but it could be present in other places.

GRASSES

The *Gramineae* with at least 30 representative species (11 native and 19 alien) constitutes by far the largest family group on The Nut. It embraces about 19% of the total flora and supports the sheep that have been grazed there intermittently for nearly 140 years. The whole summit area is now a tussock grassland in which the dominant species appear to be *Dactylis glomerata* (Cocksfoot) and *Lolium perenne* (Perennial Rye-grass), variously intermixed with the still vigorous native species *Poa australis* (Tussock Grass) and *Danthonia pilosa* (Velvet Wallaby-grass). Concomitant but less valuable introductions are *Bromus mollis, Holcus lanatus* and *Anthoxanthum odoratum,* while weedy annuals include *Vulpia bromoides* and *Aira caryophyllea.* It is probable that cocksfoot and rye-grass have been deliberately sown on The Nut for pasture purposes. Kangaroo Grass *(Themeda australis),* which was doubtless widespread in earlier times, now appears chiefly on the western slopes; *Echinopogon ovatus* and *Agropyron scabrum* are mostly weak plants of more shaded rocky places. Entirely coastal and never found far from high-water mark are *Distichlis distichophylla* and *Stipa teretifolia,* the former matted and the latter a large wind-resistant tussock.

INTRODUCED PLANTS AND WEEDS

The naturalised flora of The Nut amounts to no less than 56 species, more than one third of all plants now present. Grasses are most numerous; but there are also 9 leguminous species (clovers, medicks etc.) and 6 of *Compositae* (thistles). Hedges of boxthorn *(Lycium ferocissimum)* were planted on the cleared land by early settlers, as well as along roadsides on the Green Hills west of Stanley; these are still in existence, but only scattered bushes have appeared far away from the hedges — the seeds doubtless dispersed by berry-eating birds. An astonshing fact is the absence of blackberry *(Rubus fruticosus* agg.) which has spread only too readily in other parts of Circular Head district. A few quite localised shrubs and trees may have been deliberately planted, for example: two old bushes of holly *(Ilex aquifolium)* on the lower slopes behind Bay View Hotel, and one very large, old ivy plant *(Hedera helix)* which has crept up the centre of the southern cliff-face to such a height as to constitute a landscape feature. Water-cress *(Nasturtium officinale)* is confined to a single colony of several square yards on permanently wet soil in the gully-head of the steep S.E. slope; it may have been purposely introduced.

In the appended census of vascular plants, naturalised aliens have been indicated by an asterisk; but the list does *not* include a large number of weeds that are restricted to private gardens and roadsides adjoining the lower slopes of The Nut, e.g. in such genera as *Polygonum, Spergula, Ranunculus, Capsella, Coronopus, Sinapis, Lotus, Erodium, Euphorbia, Calystegia, Bellis, Matricaria, Arctotheca, Taraxacum.*

By far the most troublesome and aggressive weed, that has spread alarmingly in recent years, is gorse *(Ulex europaeus).* This prickly bush now covers several acres along all the gentler slopes above the town and has approached the crest of The Nut in some places. At the request of the Health & Noxious Weeds Inspector for Circular Head Municipality, an extensive spraying programme was carried out during November and December, 1964, with gratifying results; but follow-up treatments will probably be necessary to ensure that no regeneration occurs from dormant seeds. One unfortunate side-effect of the spraying was damage to the few surviving blackwood trees and some other native shrubs, especially near more isolated thickets of gorse. Thick patches of the two tall annual thistles, *Carduus tenuiflorus* and *Silybum marianum,* were also effectively sprayed to prevent seed formation.

CENSUS OF PLANT SPECIES ON "THE NUT"

The present enumeration is divided into three sections: *A.* Vascular flora (ferns and seed-plants), *B.* Bryophytes (mosses and hepatics), *C.* Lichens. Genera in the last two sections are arranged alphabetically, without reference to their family affinities — still debatable among cryptogamic specialists. Vascular species are grouped in families the arrangement of which, with slight modifications, conforms to the systematic scheme adopted by Engler and Prantl in *Die Natürlichen Pflanzenfamilien* (1887 - 1902).

The names of naturalised alien species are prefixed by an asterisk (*), while the prefixing sign † denotes a species confined to a small fern gully below the S.E. hanging valley. Frequencies of occurrence are indicated by the following abbreviations in Italics after each name and authority:

c	common and widespread
r	rare
vr	very rare (only 1 or 2 individuals noted)
loc	localised
occ	occasional or scattered

A. VASCULAR FLORA

PTERIDOPHYTA

DICKSONIACEAE

†*Dicksonia antarctica* Labill. - *vr*

DENNSTAEDTIACEAE

†*Hypolepis rugosula* (Labill. J.Sm - *r*
Pteridium esculentum (Forst.f.) Nakai - *c*
†*Histiopteris incisa* (Thunb.) J.Sm. - *r*

ADIANTACEAE

Adiantum aethiopicum L. - *r.* (near fern gully)

GRAMMITIDACEAE

Ctenopteris heterophylla (Labill.) Tindale - *loc* (N.E. scarp)

POLYPODIACEAE

Microsorium diversifolium (Willd.) Copeland - *c* (on cliffs)

ASPLENIACEAE

Asplenium flabellifolium Cav. - *occ* (rock crevices)
A. obtusatum Forst. f. - *loc* (N. face, near sea)

ASPIDIACEAE

Polystichum prolifcrum (R.Br.) C.Presl - *occ* (shaded ravines)

BLECHNACEAE

Blechnum nudum (Labill.) Mett. ex Luerss. - *r.* (near fern gully)
†*B. procerum* (Forst. f.) Swartz - *r*
B. minus (R. Br.) Ettings. - *loc* (walls of dam near summit)

SPERMATOPHYTA

GRAMINEAE

Microlaena stipoides (Labill.) R.Br. - *occ*
**Briza maxima* L. - *occ*
**B. minor* L. - *occ*
**Dactylis glomerata* L. - *c*
Distichlis distichophylla (Labill.) Fassett - *loc* (W. base)
Poa australis, sp. agg. - *c* (fine-leaved)
**Festuca rubra* L - *loc* (N.edge)
**Vulpia bromoides* (L.) S.F. Gray - *c*
**Lolium perenne* L. - *c*
**Bromus mollis* L. - *c*
**B. diandrus* Roth - *c*
**B. unioloides* (Willd.) Humb et al. - *occ*
Agropyron scabrum (Labill.) Pal. Beauv. - *occ*
**Hordeum leporinum* Link - *occ*
**Parapholis incurva* (L.) Hubbard - *r* (S.W. slope)
**Avena fatua* L. - *occ*
**Aira caryophyllea* L. - *c*
**A ? cupaniana* Guss. - *occ*
**A. praecox* L. - *loc* (N. base)
**Holcus lanatus* L. - *c*
**Anthoxanthum odoratum* L. - *c*
Dichelachne crinita (L.f.) Hook.f. - *c*
Agrostis billardieri R.Br. - *occ*
**A. tenuis* Sibth. - *loc* (S. base)
**Lagurus ovatus* L. - *loc* (chiefly S.W.)
Echinopogon ovatus (Forst.f.) Pal. Beauv. - *occ* (in shade)
Danthonia pilosa R.Br. - *c*
Stipa teretifolia Steud. - *loc* (N. & W. near sea)
S. elatior (Benth.) Hughes - *loc* (chiefly W. & N.W.)
Themeda australis (R.Br.) Stapf - *loc* (chiefly W. slopes)

CYPERACEAE

Scirpus nodosus Rottb. - *occ* (N. & W. slopes)
Lepidosperma gladiatum Labill - *loc* (lower N. & W. slopes)
L. laterale R.Br. var. *majus* Benth. - *occ*
†*Carex appressa* R.Br. - *r*
C. breviculmis R.Br. - *occ*

CENTROLEPIDACEAE

Centrolepis strigosa (R.Br.) Roem. & Schult. - *occ* (high S. ledges)

JUNCACEAE

Luzula campestris (L.) DC. - *r* (S. face)
†*Juncus pallidus* R.Br. - *occ*

LILIACEAE

Lomandra longifolia Labill. - *c*
Bulbine bulbosa (R.Br.) Haw. - *occ*
B. semibarbata (R.Br.) Haw. - *loc* (S. face)
Dianella revoluta R.Br. - *occ*

IRIDACEAE

Diplarrena moraea Labill. - *c* (on plateau)

URTICACEAE

†*Urtica incisa* Poir. - *r*

PROTEACEAE

Banksia marginata Cav. - *occ*

POLYGONACEAE

**Rumex acetosella* L. - *c*
**R. crispus* L. - *occ* (S. base)
**R. pulcher* L. - *occ* (S. base)

CHENOPODIACEAE

Rhagodia nutans R.Br. - *occ* (crevices)
R. baccata (Labill.) Moq. - *c* (slopes)
Chenopodium glaucum L. - *loc* (N.E. base)
**Atriplex hastata* L. - *loc* (W. & N.W. against sea)
Salicornia australasica (Moq.) Eichler - *loc* (W. & N. against sea)

AIZOACEAE

Carpobrotus rossii (Haw.) N.E. Br. - *loc* (W. & N. near sea)
?*Disphyma australe* (Soland.) J. M. Black - *loc* (presence uncertain)
Tetragonia implexicoma (Miq.) Hook.f. - *occ*

PORTULACACEAE

Calandrinia calyptrata Hook.f. - *occ*

CARYOPHYLLACEAE

Stellaria pungens Brongn. - *c*
**S. media* (L.) Cyrillo - *occ* (near town)
Sagina apetala L. - *c*
S. procumbens L. - *loc* (N.E. base)
**Cerastium glomeratum* Thuill. - *c*
**Polycarpon tetraphyllum* Loefl. - *c*
**Silene anglica* L. - *occ*
Scleranthus biflorus (Forst. & Forst f.) Hook.f. - *loc* (S.W. edge)

*FUMARIACEAE

**Fumaria officinalis* L. - *r* (S. near town)

Aerial view of The Nut (and Stanley).
Photo : by courtesy Department of Lands & Surveys.

(Top): The Nut, far N.W. Tasmania (looking S.E. across Gofrey's Beach, from "Highfield") — *Photo.: by courtesy "The Mercury."*

(Bottom): Wind-pruned old trees of *Bursaria spinosa* on western declivities of The Nut, Jan. 1965 (direction of growth almost parallel to hill-slope).

(Top): Shore Spleenwort *(Asplenium obtusatum)* in a basalt crevice against the sea — *Photo. : Trevor Pescott.*

(Left): White Iris or Butterfly Flag *(Diplarrena moraea)*, abundant at summit of The Nut — *Photo. : Late Fred Bishop.*

(Right): White Correa *(Correa alba)*, conspicuous on slopes of The Nut — *Photo. : Late Fred Bishop.*

(Left): Shore Spleenwort *(Asplenium obtusatum)*, showing upper and lower surfaces toward apex of soriferous fronds — *Photo.: H. J. King.*

(Right): Hoary Sunray *(Helipterum albicans* var. *incanum)*, dried specimen in Melbourne Herbarium collected by Dr. Joseph Milligan on The Nut, 3 Nov. 1841.

CRUCIFERAE
Cardamine ? heterophylla Hook. - *occ*
†**Nasturtium officinale* R.Br. (one large colony)
**Raphanus raphanistrum* L. - *occ* (S. near town)

CRASSULACEAE
Crassula sieberiana (Schult. & Schult.f.) Druce - *c* (on rocks)

PITTOSPORACEAE
Bursaria spinosa Cav. - *c*

ROSACEAE
Rubus parvifolius L. - *occ*
**Crataegus oxyacantha* L. - *r* (S. base)
Acaena anserinifolia (Forst. & Forst.f.) Druce - *c*
A. ovina A. Cunn. - *occ*

MIMOSACEAE
Acacia melanoxylon R.Br. - *r* (S.E. slopes)
A. verticillata (L.Hérit.) Willd. var *ovoidea* (Benth.) Benth. - *occ* (prostrate)

PAPILIONACEAE
Pultenaea daphnoides Wendl. - *r* (S. edge)
Bossiaea prostrata R. Br. - *r* (S. edge)
**Ulex europaeus* L. - *c* (a pest on S. & S.W. slopes)
**Genista monspessulana* (L.) L.A.S. Johnson 1962 - *occ* (slopes above town)
**Trifolium dubium* Sibth. - *c*
**T. tomentosum* L. - *occ*
**T. repens* L. - *occ*
**Medicago polymorpha* L. - *occ*
**M. lupulina* L. - *loc* (W. scree slopes)
**Vicia sativa* L. - *occ*
**V. hirsuta* (L.) S.F.Gray - *occ*
Kennedia prostrata R.Br. - *r* (W. scarps)

GERANIACEAE
Geranium potentilloides L'Hérit. ex DC. - *c*
Pelargonium australe Willd. - *occ* (cliffs)

OXALIDACEAE
Oxalis corniculata L. - *occ*

RUTACEAE
Correa alba Andr. - *c* (among rocks)

EUPHORBIACEAE
Poranthera microphylla Brongn. - *occ*

*AQUIFOLIACEAE
**Ilex aquifolium* L. - *vr* (2 plants on lower S. slopes)

RHAMNACEAE
Pomaderris apetala Labill. - *c* (slopes)

VIOLACEAE
Viola hederacea Labill. - *occ* (in shade)

MYRTACEAE
Eucalyptus viminalis Labill. - *loc* (few bushes on W. declivities)
Melaleuca ericifolia Sm. - *c* (slopes)

ONAGRACEAE
Epilobium junceum Forst. f. ex Spreng. - *occ*

HALORAGACEAE
Haloragis tetragyna (Labill.) Hook.f. - *occ* (S. slopes)

UMBELLIFERAE
Hydrocotyle hirta R.Br. ex A. Rich. - *loc* (S. cliffs, in shade)
Daucus glochidiatus (Labill). Fisch. et al. - *occ*
**Conium maculatum* L. - *loc* (lower S. slopes)
Apium prostratum Labill. - *loc* (W. & N.W. against sea)

ARALIACEAE
**Hedera helix* L. - *vr* (one old large plant on S. face)

EPACRIDACEAE
Styphelia humifusa (Cav.) Pers. - *loc* (upper S.W. slopes)
S. parviflora Andr. - *c* (slopes)
S. oxycedrus Labill. - *r* (scattered old bushes on N. & S. scarps)

PRIMULACEAE
**Anagallis arvensis* L. - *c*

APOCYNACEAE
Alyxia buxifolia R.Br. - *r* (N. & S. cliffs)

CONVOLVULACEAE
Dichondra repens Forst. & Forst.f. - *c*

LABIATAE
**Marrubium vulgare* L. - *loc* (lower S. slopes)

SOLANACEAE
**Lycium ferocissimum* Miers - *occ* (S.W. & W. base)

SCROPHULARIACEAE
**Veronica arvensis* L. - *loc* (S. face)

MYOPORACEAE
Myoporum insulare R.Br. - *loc* (W. & N.W. near sea)

PLANTAGINACEAE
**Plantago coronopus* L. - *loc* (N.E. base)

RUBIACEAE
†*Coprosma quadrifida* (Labill.) Robinson - *r*
†**C. repens* A.Rich. - *vr* (one old bush)
Opercularia varia Hook.f. - *occ*
Galium australe DC. - *occ* (shaded crevices)
G. gaudichaudii DC. - *occ* (among rocks)
**G. aparine* L. - *occ* (S. base)

CAPRIFOLIACEAE
†*Sambucus gaudichaudiana* DC. - *r*

CAMPANULACEAE
Wahlenbergia gracilenta Lothian - *occ*
W. quadrifida (R.Br.) Alph.DC. - *occ*

LOBELIACEAE
Lobelia alata Labill. - *loc* (N.E. base)

GOODENIACEAE
Goodenia ovata Sm. - *occ* (slopes)

COMPOSITAE
Olearia phlogopappa (Labill.) DC. - *c* (slopes)
O. ? argophylla (Labill.) Benth. - *vr* (one plant in N.E. ravine)
Gnaphalium japonicum Thunb. - *occ*
G. luteo-album L. - *loc* (N.E. scree)
Helipterum albicans (A.Cunn.) DC. var. *incanum* (Hook.) P.G.Wilson - *loc* (high ledges at N. & N.E. scarps)
Leptorhynchos squamatus (Labill.) Lessing - *occ.* (S. & S.W. scarps)
Senecio lautus Forst.f. ex Willd. - *c*
S. linearifolius A.Rich. - *occ* (slopes)
S. hispidulus A.Rich. - *occ*
**S. mikanioides* Otto ex Walp. - *loc* (lower S. slopes)
**Cirsium vulgare* (Savi) Ten. - *c*
**Carduus tenuiflorus* Curtis - *c*
**Silybum marianum* (L.) Gaertn. - *loc* (S. & W.)
**Hypochoeris radicata* L. - *c*
Sonchus megalocarpus (Hook.f.) J.M.Black - *loc* (N.E. scree)
**S. oleraceus* L. - *occ*

B. BRYOPHYTES

MUSCI (Mosses)

Barbula pseudopilifera C.Muell. & Hampe - on rocks & earth

B. torquata Tayl. - rocks & earth

Bartramia papillata Hook.f. & Wils. - shaded earth

Breutelia affinis (Hook.) Mitt. - rocks

Bryum billardieri Schwaegr. - earth

B. blandum Hook.f. & Wils. - damp shaded rock walls (N.E.)

B. campylothecium Tayl. - earth

B. dichotomum Hedw. - rocks & earth

Campylopus bicolor (Hornsch.) Hook.f. - rock faces & ledges

C. introflexus (Hedw.) Brid. - earth

Ceratodon purpureus (Hedw.) Brid. - rocks & earth

Fissidens pungens C. Muell. & Hampe- shaded earth

F. taylori C. Muell. - shaded earth

Funaria hygrometrica Hedw. - earth

Grimmia laevigata (Brid.)Brid. - rocks

G. pulvinata (Hedw.) Sm. - rocks

Hedwigia imberbis (Sm.) Spr. - rocks

Hypnum cupressiforme Hedw. - earth & rotting wood

Lembophyllum clandestinum (Hook.f. & Wils.) Lindb. - rocks

†*Pterygophyllum dentatum* (Hook.f. & Wils.) Mitt. - wet shaded earth

Rhacomitrium crispulum (Hook.f. & Wils.) W. Wils. - rocks

Rhacopilum convolutaccum (C.Muell.) Mitt. - earth & shaded rocks

Rhynchostegium tenuifolium (Hedw.) Jaeg. - damp earth & fallen sticks

Sematophyllum homomallum (Hampe) Broth. - bark of trees, rocks

Thuidium furfurosum (Hook.f. & Wils.) Jaeg. - earth & shaded rocks

Tortella calycina (Schwaegr.) Dixon - rocks & soil

Tortula papillosa Wils. ex Spruce - bark of old *Bursaria*

Triquetrella papillata (Hook.f. & Wils.) Broth. - rocks & earth

Weissia controversa Hedw. - rocks & earth

Zygodon intermedius Bruch & Schimp. - rock faces

HEPATICAE (Liverworts)

Frullania falciloba (Tayl.) Tayl. - rock faces

Lophocolea semiteres (Lehm.) Mitt. - old wood, rocks & shaded earth

Lunularia cruciata (L.) Dumort. - shaded soil

†*Metzgeria furcata* (L.) Dumort. - damp sticks & shaded earth

Plagiochila fasciculata Lindenb. - shaded earth under shrubs (N.E.)

C. LICHENS

Caloplaca cinnabarina (Ach.) Zahlbr. - rocks

Cladonia aggregata (Sw.) Ach. - earth & rotting wood

Lecanora ? sordida (Pers.) Th.Fr. - rocks

Parmelia conspersa Ach. - rocks

Ramalina ecklonii (Spreng.) Mey. & Fw. - dead *Bursaria* twigs

R. sp. - dead *Bursaria* twigs

Stereocaulon ramulosum (Sw.) Rausch - shaded rock surfaces

Sticta crocata (L.) Ach. - rocks & earth

Sticta sp. - rocks & shaded earth

Teloschistes chrysophthalmus (L.) Beltr. - dead *Bursaria* twigs

Usnea sp. (barren) - old twigs of *Styphelia oxycedrus*

Xanthoria parietina (L.) Beltr. - rocks & dead bark

BOTANICAL INVESTIGATIONS IN CIRCULAR HEAD DISTRICT

In its original application, the name Circular Head referred only to the detached bluff so named by Flinders; but, with arrival of the Van Diemen's Land Company's pioneers in 1826, it was soon applied to the whole Stanley Peninsula (6 miles long) embracing the 20,000 acres of grazing land granted here to this Company. On page 39 of *Bailliere's Tasmanian Gazetteer* for 1877 the name is used in the latter sense. Eventually there evolved a Circular Head Municipality, including not only Stanley Peninsula itself but a large area of the hinterland between and beyond the Black and Duck Rivers. The locality "Circular Head" appearing for various species of plants in the three major works on the Tasmanian flora, by J. D. Hooker (1855-60), W. W. Spicer (1878) and L. Rodway (1903), implies the last much wider regional sense. Between them Hooker and Spicer ascribed 135 vascular species to Circular Head district, 33 of these being inhabitants of heathland areas and only 12 others being represented now on The Nut. Hooker's 110 records were based exclusively on the collections of Ronald Gunn, but Spicer's 53 records included some of his own collectings and those of correspondents at Stanley. Of the 30 species of orchids cited for Circular Head by Hooker (1858), no less than 18 are now represented by duplicate Gunn collections in the National Herbarium of New South Wales; but, in addition, Sydney Herbarium has eleven other orchid species among the Gunn specimens from this region. (*See* MS. list of R. C. Gunn's collection of Tasmanian orchids, compiled by the late Rev. H. M. R. Rupp for Sydney Herbarium).

The earliest botanical observer in this far north-western district would seem to have been Robert William Lawrence (farmer at "Formosa" Estate on the Lake River) who made an excursion to Circular Head and Cape Grim about the beginning of 1829, when 22 years of age. Lawrence describes in his diary a liliaceous plant from Circular Head which could only be *Bulbine semibarbata* — still to be found on The Nut. On 3 May, 1830 he received from Dr. J. H. Hutchinson (the V.D.L. Company's doctor and book-keeper at Circular Head) "an assortment of native seeds". This promising young botanist and intimate friend of Ronald Gunn died on his 26th birthday, 18 Oct. 1833.

The Quaker missionary and collector, James Backhouse (1843), landed at Circular Head on 30 Oct. 1832, remarking that Edward Curr had "well fenced fields with luxuriant herbage of rye-grass and white clover". After visiting Woolnorth and Cape Grim, he returned on 13 Nov. 1832 and spent a month with Edward Curr. Apparently he did not climb The Nut — or, at least, there is no description of it in Backhouse's published journal, and he scarcely comments at all on the vegetation of the peninsula. No plant collections seem to have been made here, but type material of *Correa backhousiana* Hook. (1834) was collected by the missionary at Cape Grim. Shortly afterwards, Backhouse journeyed past Rocky Cape and Wynyard to Emu Bay. During the next six weeks (15 Dec. 1832-26 Jan. 1833), and in company with Dr. Joseph Milligan, he made botanical sorties in the triangle between Emu Bay (Burnie), St. Valentine's Peak (sources of the Emu & Hellyer Rivers) and Mole Creek. Probably his most significant collection, while in this region, was the type specimen of Gunn's Orchid (*Sarcochilus australis)* which was taken on 22 Dec. 1832 at Emu Bay — "growing upon the branches of the larger shrubs, especially upon *Coprosma spinosa* [= *C. quadrifida*]".

By far the most assiduous and important early investigator of Circular Head vegetation was Ronald Campbell Gunn who held the position of Police Magistrate in this district for more than two years, Aug. 1836 to 14 Oct. 1838, at an annual salary of £300. Details of his botanical activities there have been preserved in a series of letters written to W. J. Hooker, the illustrious British botanist at Glasgow University (later Director of the Royal Botanic Gardens at Kew). Gunn's letter of 2 September 1836 mentions his appointment as P.M. to the Van Diemen's Land Company's north-western territories (Hampshire and Surrey Hills, Emu Bay, Circular Head and Woolnorth) and concludes: "I think I shall be able to send you a few novelties". The duties were not arduous, allowing Gunn ample opportunity and leisure for collecting botanical as well as other natural history specimens. During these earlier days at Circular Head he gave hospitality to Mr. Thomas K. Short, an unscrupulous quasi-naturalist from Nottingham who then, and for long afterwards, was a "thorn in the flesh" to Gunn. The generous Tasmanian plantsman stood guarantor for Short's mounting debts, and finally had to pay that imposter's creditors the crippling sum of £218.5.6 from his own meagre resources.

On 16 November 1836, three months after his arrival, Gunn wrote to announce shipment of about 150 numbers of dried plants to Hooker from Circular Head district; and he mentioned having also "turned shell collector", with probably 70 - 100 species to be sent later. Within a few days, 20 Nov. 1836, he again refers by letter to the 156 numbers (617 - 772, not including cryptogams) which were recently shipped. On 31 March 1837 he describes the packing of "an immense chest of sundries in the Natural History line" and in a separate box a collection of sea-shells — three-quarters of them collected for him by Mrs. Charlotte Smith (née Macdonald), an enthusiastic local resident. The dried plants included specimens from Circular Head, Woolnorth, Rocky Cape, Hampshire and Surrey Hills. Gunn alludes to the epiphytic orchid *Gunnia australis* [= *Sarcochilus australis*] as being "abundant within four to five miles of Circular Head, parasitic on the *Aster argophyllus, Pomaderris apetala* and 219"; but he later writes that it came from "a dense almost impenetrable forest" commencing about eight miles south from his house — obviously the forested mountain gullies on basaltic loam around modern South Forest and Mengha.

The algae sent by Gunn to Hooker were apparently all collected by his friend Mrs. Charlotte Smith, wife of John Grant Smith who had come from Glasgow and was then storekeeper with the V.D.L. Company at Stanley. Mrs. Smith is described as a "very estimable fellow resident" to whom Gunn also paid the following tribute:

> "I am under the greatest obligations for her great attention in changing my large collection of plants when in paper drying, during my repeated absences to Woolnorth, to the Hampshire Hills and elsewhere, and without her my collection would have been far less, and a great proportion of those collected would have been spoiled."

Among Mrs. Smith's algae where the type specimens of *Dasyphloea tasmanica, Gelidium glandulifolium* and *Polyphacum smithiae* — described in her honour ten years later (1847) by J. D. Hooker and W. H. Harvey — also *Rhodymenia coccinea.* The Smith family had arrived at Circular Head in September 1836 and they left the district permanently at the beginning of 1838, Mrs. Smith dying in Launceston on 8 October 1838 at the early age of 29. In 1840 the great British botanist, Dr. John Lindley, honoured Mrs. Smith by bestowing her maiden name upon a new genus of Australian orchids — Macdonaldia, which is now merged with Thelymitra. The type of his *M.smithiana* [=*T.flexuosa*] had been collected by her near Circular Head.

Finally on 26 April 1838, a year after packing it, Gunn dispatched his second large case of dried material to W. J. Hooker — nos. 773-1117 or 345 collections which were almost entirely from the N.W. coast of Van Diemen's Land. Many were from "The Peninsula or Circular Head"; the orchids, of which J. D. Hooker (1858) cites 30 species, came chiefly from "a belt of heathy plains which extend to Woolnorth" and some of them had been collected by Mrs. Smith. Another small collection of Mrs. Smith's algae was included, also ferns, mosses and lichens of Gunn's own gathering. R. C. Gunn left Stanley on 14 October 1838, upon accepting the position of Assistant Police Magistrate at Hobart; but he was back to collect the orchid *Acianthus reniformis* in Sept.-Oct. 1844, and again in Oct. 1851 he revisited the district and furnished a report to the Royal Society of Van Diemen's Land (1852). He does not seem to have compiled any list of plants occurring on The Nut, but specimens of *Helipterum albicans* var. *incanum* and *Styphelia oxycedrus* (in Kew Herbarium) are proof that he ascended this bluff, at least in Sept. 1838. Among his more noteworthy collections in the district was *Drimys lanceolata* (Mountain Pepper), of which J. D. Hooker (1855) remarks: "descending to the level of the sea at Circular Head". No one else has noted this species anywhere near the sea in far north-western Tasmania, but it certainly grows on the southern portion of King Island at altitudes below 400 ft.; could there still be a survival of this shrub on the almost inaccessible northern ravines of The Nut? Gunn's name is perpetuated in those of at least 16 species of Tasmanian flowering plants, as well as in several cryptogams.

Shortly after Ronald Gunn's departure Commander J. Lort Stokes, during his Admiralty survey of the N.W. Tasmanian coast on H.M.S. *Beagle,* spent the day of 18 December 1838 at the small Circular Head settlement; he returned within a few weeks as the guest of Edward Curr for two days (6-8 February 1839). Surgeon B. Bynoe was the natural history collector on the *Beagle;* but, although he collected bird skins on nearby Three Hummock Island and plant specimens on several other Bass Strait islands, he apparently took none of the latter from Circular Head. There is no mention in Stokes's journal (1846) that he or Bynoe climbed The Nut. In the latter half of 1840 the Polish explorer, Paul (later Sir Paul) Edmund de Strzelecki (1841), made an excursion along the coast of Tasmania's far north-west, including Circular Head where he also was aided by the hospitable Edward Curr; it is doubtful that plant-collecting was part of Strzelecki's programme at the time, and no specimens have been cited from this journey.

Dr. Joseph Milligan, who was surgeon to the V.D.L. Company at Surrey and Hampshire Hills from 1830 to 1841, visited The Nut ("C. Hd. Bluff" on his labels) on 3 November 1841 and collected *Helipterum albicans* var *incanum* — the specimens now in Melbourne Herbarium. Milligan was by then Inspector of Convict Discipline, but he most probably had made previous visits to the Stanley area. About 1867 Walter N. Bissill of Ravenswood, Vic., collected here a few plant specimens (also in Melbourne Herbarium), although it is not known how he came to be over in Tasmania. T. Stephens M.A., F.G.S. (an Inspector of Schools) was at Circular Head in February 1872, when a local farmer, S. B. Emmett, drew his attention to the rare Slender Tree-fern *(Cyathea cunninghamii)* — 40 ft. high —, probably toward the Arthur River; the occurrence was made the subject of a note to the Royal Society of Tasmania (1873). Stephens revisited this district in 1912, after a lapse of 40 years. H. Thomas A. Murray was Police Magistrate and Customs Collector for Circular Head district in the 1860's and 1870's. He carried on a frequent correspondence with R. C. Gunn (then resident at Launceston and latterly collector of the Western Railway rates). These letters cover the period February 1860 to July 1876 and include many comments on pasture plants and weeds at Circular Head: e.g. we learn that Sheep Sorrel was well established and a nuisance to farmers by December 1860, also that Spotted Medick was becoming a local problem in November 1861.

The name of Skelton Buckley Emmett will always hold a special place among resident botanical observers and collectors in Tasmania's far north-west. Arriving at Circular Head from Hobart in 1835, at the age of 17, he was employed by the V.D.L. Company until 1853 when he returned to the Capital. Emmett came back to Circular Head district in 1856, as a married man, and took up farming at Forest (8 miles south from Stanley) where he remained until retiring again to Hobart a few years before his death in 1898. About 1872 he began corresponding with Baron von Mueller at Melbourne, and a letter of 25 May 1874, describing the luxuriant vegetation of the Arthur River region, doubtless whetted Mueller's own desire to visit these "back ranges," which he did in Emmett's company during the first week in February 1875 — his only excursion to northern Tasmania. The result was a large number of Circular Head specimens for Melbourne's big colonial herbarium. Neither man would seem to have collected any specimens on The Nut; but Mueller obtained the alga *Codium spongiosum* on a Stanley beach. S. B. Emmett later sent plants to Mueller from Mt. Norfolk in the Russell Ranges (1878) and from Mt. Roland near Sheffield (1880).

The Rev. W. W. Spicer (1878) comments on the association of the introduced plants *Trifolium tomentosum* and *Caucalis nodosa* that he saw while at Circular Head (probably about 1875); he returned to England in March 1878 and died at Notting Hill (London) a year later. The Rev. Henry D. Atkinson, Anglican clergyman at Stanley between 1877 and 1890, took a great interest in the flora of the district and especially in forest conservation. He made strenuous efforts to have reserves proclaimed in order to safeguard such rare plants as the Slender Tree-fern *(Cyathea cunninghamii),* but to little avail. His son, the Ven. Archdeacon H. B. Atkinson, later devoted much time to studying the

plant-life of Tasmania, making a large collection of orchids from various localities and recording several species as new to the State. There are a number of specimens in Melbourne Herbarium gathered by Miss Emma Oakden in the course of a short stay at Stanley, 30 January - 6 February 1888, one of them being *Helipterum albicans* var. *incanum* from The Nut. A resident of Launceston, she had also within the previous three years forwarded botanical items to F. von Mueller from George Town, Hamilton district and Mt. Wellington. The only other notable botanist at Circular Head last century seems to have been W. A. Weymouth who in April 1892 gathered mosses and lichens in this region (including *Bryum ?billardieri* on The Nut), some of his numbers being represented at Melbourne Herbarium. Victorian zoologists H. P. C. Ashworth and D. Le Souef, while en route for Albatross Island, spent two days at Stanley (23-25 November 1894). They ascended The Nut, but made no botanical observations or collections there, and remarked on the recent planting of Marram Grass to stay the landward encroachment of beach dunes.

Collectors in the present century have been few and far between. The late Government Botanist of Tasmania, Leonard Rodway, gave no indication that he was personally familiar with the vegetation of Circular Head, although he has cited a number of hepatic species from nearby Trowutta (1917). The late Mrs. Florence Perrin obtained some algae (including *Scaberia agardhii)* at Stanley, but collected more extensively at Montagu and Cape Grim where she went with her husband in three successive years (April 1947, April 1948 and April 1949). Mr. Harold Trethewie, secretary to the Stanley Marine Board, collected orchids between Stanley and Forest during 1946, his specimens embracing the long "lost" *Prasophyllum brachystachyum* (from its type locality) which was submitted to the late W. H. Nicholls (1948). From January 1931 to December 1941 Mr. M. J. Firth taught natural science at the Smithton High School, conducting a number of field excursions over the surrounding button grass plains and heaths where orchids were abundant. Latterly, as District Horticultural Officer with the Department of Agriculture at Devonport and then Wynyard, his increasing preoccupation with these intriguing flowers has culminated in the useful, illustrated monograph *Native Orchids of Tasmania* (1965), wherein are many references to Circular Head and other parts of the far north-west.

As supervisor of natural history instruction in Tasmanian State Schools, Miss Janet Somerville visited Stanley several times during the 1940's and 1950's. She took the opportunity to explore The Nut, made collections of the more interesting flora thereon and compiled a list of species. Her specimens and notes should be among material left at Hobart when Miss Somerville came to live in Melbourne in 1963, for the sake of her health. The late Raleigh A. Black, whose excellent herbarium of Tasmanian plants was purchased for the National Herbarium of Victoria in 1957, spent two days in the autumn of 1947 (23-24 April) between Smithton and Woolnorth, visiting Cape Grim and Woolnorth Point as guest of Mr. George Wainwright (V.D.L. Co. Manager). A small botanical collection, including the endemic *Eucalyptus simmonsdii,* was made in this district. Finally, during the past 15 years Mr. W. D. Jackson (Botany Dept., University of Tasmania) has made extensive collections of eucalypts along the N.W. coast, including Rocky Cape, Smithton and Woolnorth, but not the Stanley Peninsula.

THE FUTURE OF THE FLORA

With the advent of mechanised farming since World War II, drainage of remaining swamps and reclamation of poor heathlands through treatment with trace elements, much scrubby country previously regarded as worthless has now been cleared for settlement. Repeated fires are inexorably reducing the protective shrubberies on coastal dunes and sand-spits, permitting wind erosion. All around the north-west coast a retreat of native flora is increasingly evident, and the process is likely to accelerate. Some very localised plants are already in a precarious position, e.g. the limited occurrence of Saw Banksia *(B. serrata)* near Sisters Creek, for the preservation of which a body of enthusiastic naturalists is now endeavouring to secure a sizeable reserve in that area. A swampy heath at Rocky Cape is the only known habitat in Tasmania for a rare onion-orchid *(Microtis orbicularis)*; efforts to secure the reservation of this tract also would be commendable. The last vestige of paperbark swamp at Stanley (between the State School and Green Hills) is another small area worth leaving intact as a sample of the fast-vanishing ecosystems in this fertile part of Tasmania. The question arises: "is there anything still worthy of protection on The Nut, after 140 years of destruction and exploitation?" The writer would answer in the affirmative.

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No. 22

NATIONAL MUSEUM
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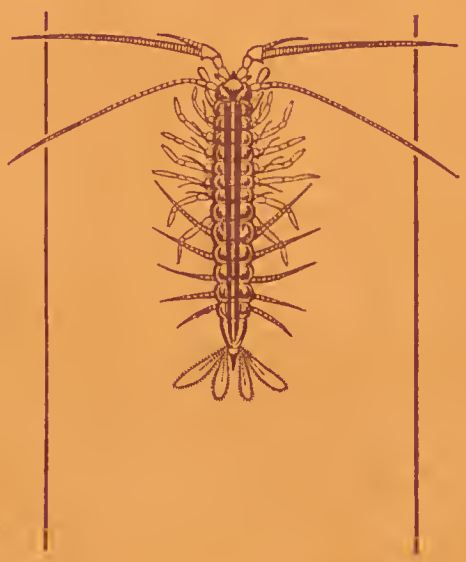
RECORDS OF THE QUEEN VICTORIA MUSEUM LAUNCESTON



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LAUNCESTON CITY COUNCIL

NOTES ON LESSER LONG-EARED BAT NYCTOPHILUS GEOFFROYI IN NORTHERN TASMANIA

by

R. H. GREEN,

QUEEN VICTORIA MUSEUM, LAUNCESTON.

Manuscript received 11 November 1965 *Published 4 May 1966*

1. INTRODUCTION

The Lesser Long-eared Bat *Nyctophilus geoffroyi* Leach is one of the most abundant bat species in Tasmania; only the Little Brown Bat *Eptesicus pumilus* appears to be more numerous. The collections of the Queen Victoria Museum reveal that it also has a wide geogrophical range within the State, specimens having been collected at Stanley, Devonport, Green's Beach, Beauty Point, Exeter, Glengarry, Launceston, Prosser's Forest, Myrtle Park, Pioneer, Great Lake, Colebrook, King Island and Flinders Island. (See Fig. 1).

Observations have been made on the species from time to time as opportunity permitted in 1963, 1964 and 1965, and during this period two maternal colonies have come under notice. Progressive collecting of live specimens from these colonies, together with banding and other activities, has permitted the collection of data from both captive and free-living animals. The birth of young in captivity has been observed.

II. MATERNITY COLONIES

(a) The *Beauty Point colony*, located about eight miles inland from the mouth of the Tamar River, was found in the ceiling of an out-building on the edge of the township. The bats were roosting in a narrow space between the corrugated iron roof and the lining boards to which it was fastened. Entry was gained by a gap between the top of the internal wall and the roof. When this colony was first visited on the morning of 27:I:1964, bats could be seen between the gaps in the ceiling boards. One was caught and removed and, while being handled, it uttered sound just audible to the human ear. Its removal from the roost caused the immediate departure of the remainder of the colony but, although two external doors were open, no bats were observed to leave the room, all continuing to fly round in the confined space until they were eventually caught. Four females and two males were thus collected. The females all showed signs of recent lactation but no juvenile or subadult bats could be found. However two juveniles had been found dead on the floor two days previous to my visit. I was informed by the owner that, four to five weeks earlier, activity in the roost had been noticeable; bats had been seen moving about the ceiling fixtures, often with juveniles clining to their fur, and vocal noises could be heard in the roost. By early January this activity had noticeably reduced. At the time of my visit the young bats had apparently been weaned and the roost partly abandoned. The site was not known to have been occupied previously nor has it been since.

(b) The *Green's Beach colony*, on the western side of the mouth of the Tamar River, was first discovered on 15:XI:1964. The bats were occupying a crevice between a wooden floor joist and a cement wall in the basement of a house. Their only entry to the basement was a one inch gap at the top of a door and the site of the roost was a further twelve feet inside the basement. Departing and returning bats often spent some time flying round inside the basement before leaving or re-entering the roost. On such flights they usually rested at intervals by alighting on ledges or the cement walls. Observations and netting were carried out on several subsequent evenings until 5:XII:1964 when the roost was found to have been abandoned. This was the only year the site was known to be occupied.

Although noise and activity were reported as being noticeable in the Beauty Point roost in mid December 1963, this was not the case in the Green's Beach roost in the latter half of November 1964. The presence of the latter colony would not have been detected but for bat faeces falling to the floor. However the juveniles in the latter instance were certainly younger and less developed than would have been the case at the time of observation at Beauty Point.

At the Green's Beach roost the bats could be seen with the aid of a flash light and after the evening exit of the adults the juveniles were usually found gathered together although they were not noticed to cling to each other. No adult bats were mist netted with young attached. When the roost was examined on 5:XII:1964 it was found to have been abandoned. The existence of an alternative roost was suggested by variation in the numbers of individuals present on each night's banding. Abandonment of the roost indicates the possibility that handling and disturbance had caused the females to remove the young to the alternative site. Analogous behaviour had been noted in this species by Ryan (1963) and in *E. pumilus* by Green (1965).

A colony found roosting in the roof of a Church at Colebrook was visited in February and March, 1963 and eight bats (6 ♀♀ and 2 ♂♂) were collected in a mist net set inside the building.

This had probably been a maternity colony.

III. BANDING

At the Green's Beach colony the bats were captured in a mist net suspended across the exit flight line in such a manner that it was not possible for bats leaving the roost to avoid the net. It is assumed with some degree of confidence that all

occupants were collected on each occasion. The period between the first and last departure was about twenty minutes. A total of twenty bats (19 ♀♀ and 1 ♂) were netted from the roost on three evenings at weekly intervals (see Table 1). Six of the females were re-netted once and one twice over this period. Of those re-netted on 28:XII:1964 only one had been banded on 20:XI:1964, and this individual was amongst those re-netted on 28:XI:1964. Two pregnant females captured on 15:XI:1964 were not banded and were retained for captive studies. Bats were seen flying in the vicinity of the net on a number of subsequent occasions but none were taken on re-entry flights. Although several bats of the species have subsequently come to hand from the Green's Beach area, none of these were banded.

IV. BREEDING

Of the ten females netted on 15:XI:1964, nine showed signs of advanced pregnancy and one was lactating, having already given birth. The nipples of this bat were distended to 3 mm. and were surrounded by a patch of naked skin about 5 mm. across. No young bats could be seen in the roost. Two of the most heavily pregnant bats were retained for captive studies and the remainder were banded and released.

Of the four taken on 20:XI:1964 three were lactating and one heavily pregnant.

Of the twelve taken on 28:XI:1964 eleven were lactating and one was heavily pregnant.

The two pregnant females retained on 15:XI:1964 were placed in a small portable cage, provided with water, and fed quantities of live blow-flies *(Calliphora sp.)*.

At 4.30 p.m. on 18:XI:1964 one of the females was found to have just given birth to a single male young. She had moved from the wall of the cage, where both females normally hung, to the floor. The young was attached to the left nipple so firmly that removal was difficult without injury to it or the mother. When handled it uttered several faint high pitched squeaks, each of about half a second's duration. It was active and continually struggled for a firmer grip on the fur with the hind feet and the thumbs.

A slight placental blood stain was noticeable around the vent of the female.

This bat failed to produce the normal number of two young and upon preparation and dissection on the following day no signs of a second foetus was found.

This is believed to be only the second recorded instance of a single birth in this species. The other was recorded by Ryan (1963).

At 6.30 p.m. on 18:XI:1964 the second female was found to have just given birth to a single young, a female, on the floor of the cage. The parent was picked up and placed on the palm of the hand, the young being firmly attached to the nipple and ventral fur. She made no attempt to escape but rested quietly with the tail slightly turned under to form a pocket. Here she tended the young by turning her head beneath her body and continually licking the fur and patagium of the young.

Ten minutes after the estimated time of birth a slight heaving of the parent's body was noticed, which was followed by the birth of a second young. By slightly raising the tip of the tail it was possible to watch the birth.

Contractions occurred at intervals of about six seconds and after about a minute the young, a second female, was born tail first. Contractions ceased before the head was expelled, the parent then rested, and the young freed its head by its own efforts. It immediately became active and crawled beneath the parent, in search of the nipple. Its twin was already fastened on the left side. In about one minute it located the right nipple and became fastened to it.

At this stage both young were still attached to the parent by the umbilical cord, though that of the first born was now devoid of blood. The female and twins were then returned to the cage. An hour later the umbilical cord of the first born was found to have parted and that of the second was still intact but colourless.

At 11 p.m. both young were found on the floor of the cage and the parent was resting quietly in its usual roost about twelve inches above. Both young were calling vigorously with faint high pitched squeaks. They were presented to the parent and she accepted them without fuss. There they both quickly located the nipples and became atached by teeth and claws.

The following day both parents, each with their young attached to the ventral surface, were removed from the cage and allowed to fly round in a closed room. Their actions appeared quite normal and they did not appear hindered in any way by the presence of their burdens.

When at rest on a vertical surface the parent normally hangs head down and the weight of the young is taken partly by the patagium which becomes distended to form a cradle-like pocket hanging outwardly over the humerus. (See Plate 2).

In each instance the birth occurred in daylight hours. The seven births of *N. geoffroyi* recorded by Ryan (1963) also occurred during daylight hours.

V. GROWTH AND DEVELOPMENT

The following stages were recorded from eight individuals. (For measurements see Table 2).

Reg. nos. 1964:1:292-4, 1.45 gm. to 1.85 gm. in weight, born in captivity on 18:XI:1964, were naked at birth except for a few fine hairs in the region of the lips. Vibrissae were not prominent. Most milk teeth were well through the gums. (See Fig. 2). All the incisors were tri-cusped, the upper two pairs being well spaced and the lower three pairs more closely grouped and markedly inclined towards the mid line.

The upper canines were bi-cusped, with the minor cusp situated on the inward side of the major cusp. The lower canines were tri-cusped with the outer cusp longest. Two pairs of pre-

Plate 1. Adult female *N. geoffroyi* and suckling twins at one day old.

Plate 2. Adult female *N. geoffroyi* with twins in the resting position. The patagium is distended by the twins to form pockets which hang outwardly over the humerus.

Fig. 1 (Bottom). Sketch map showing the localities mentioned in the text where specimens of *N. geoffroyi* held in the Queen Victoria Museum were collected. "♀" indicates the maternal colonies.

Plate 3. Adult female *N. geoffroyi* and suckling single young at one day old.

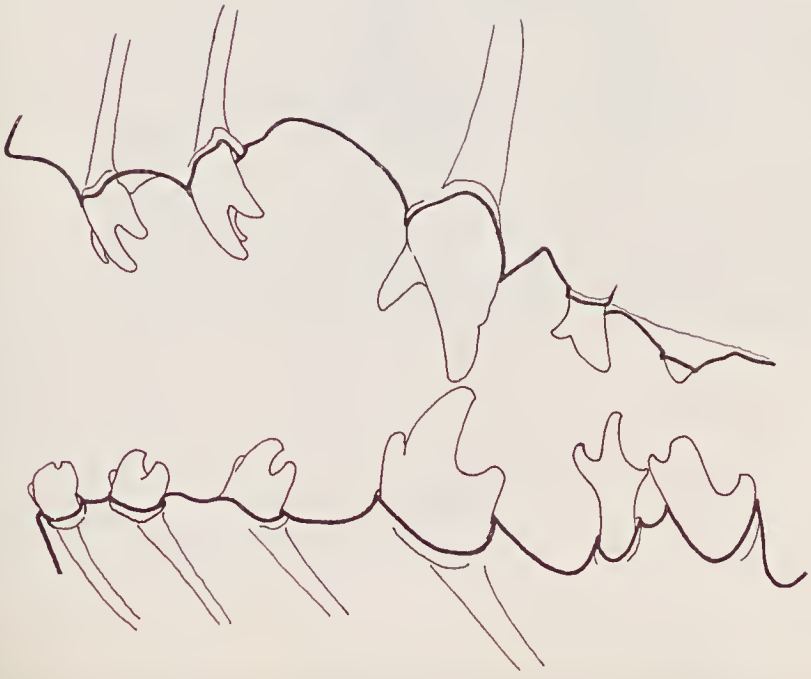

Fig. 2 (Bottom). Showing the deciduous milk teeth in the left side jaws of *N. geoffroyi* at one day old.

Plate 4. Juvenile *N. geoffroyi* Reg. no. 1964:1:303.

molars were usually present in each jaw. The anterior upper was bi-cusped whereas the posterior had only a single cusp, was more robust, but not as advanced in eruption as the former. Both pairs of lower premolars were tri-cusped.

The general morphology of the teeth was such as to give the young bats a very secure grip on the fur or nipples of their parent and was very similar to that found in *Eptesicus pumilus* (Green 1965).

Reg. no. 1964:1:303 (2.39 gm.) was collected on 28:XI:1964. It appeared naked but under microscopic examination fur was found to have erupted over most of the body, particularly on the dorsal surface. (See Plate 4). Vibrissae were becoming noticeable (to 2 mm.).

The normal complement of milk teeth was still present but in this instance the central pair of upper incisors were bi-cusped. An additional fine needle-like milk tooth, which appeared to be non functional, was present where the second molar would erupt in the left upper jaw.

Reg. no. 1964:1:5 which was found in a dessicated condition beneath the Beauty Point roost on 25:I:1964 was noticeably well furred, that on the dorsal surface reaching to 1.5 mm. and the vibrissae to 3 mm. All the milk teeth were present but the permanent lower premolars had commenced to erupt just behind the milk premolars.

Reg. no. 1965:1:1 (5.78 gm.) was collected on 29:XII:1964 when it flew into a house at Green's Beach. The dorsal fur and vibrissae reached to 5 mm. It appeared to be independent of its parent but was smaller than average and apparently not fully grown. The complete set of permanent teeth had recently erupted and gum bruising was still noticeable. The upper milk incisors were still present at the front of the developing permanent incisors.

Reg. no. 1964:1:6 was found recently dead beneath the Beauty Point roost on 25:I:1964. Dorsal fur and vibrissae reached to 5 mm. The full set of permanent teeth had erupted but the upper milk incisors were still present at the front of the permanent incisors.

Reg. no. 1964:1:290 (8.24 gm.) is the largest specimen collected to date. The measurements were taken one day after she had given birth to a male, Reg. no. 1964:1:292.

VI. MISCELLANEOUS

In the third week of January 1964 I was told of the existence of a quantity of bat faeces on the eathern floor of a basement garage beneath a newly built shack at Green's Beach. Upon investigation I was unable to find a diurnal roost though fresh faeces was present. Consequently a watch was maintained on two successive evenings. At dusk on both occasions at least three bats were seen to fly into the basement from outside by way of the garage opening. They repeatedly departed and re-entered and on numerous occasions rested for several minutes on a ledge round the top of the foundations. Two individuals, both females, were subsequently hand caught, identified as *N. geoffroyi*, banded and released. The possibility of a food attraction was not evident though a close watch was kept for the presence of insects.

The quantity and distribution of bat faeces indicated that such flights must have occurred for several weeks but they were not noticed again following my interference. No explanation can be advanced for this behaviour, but the site may have served as a nocturnal roost to which the bats retreated for short periods between hunting flights.

Two such nocturnal retreats of *N. geoffroyi* were observed in Victoria by Ryan (1963).

ACKNOWLEDGEMENTS

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Thanks are also due to Mrs. Cameron, Beauty Point, and Mr. and Mrs. E. A. Stone, Green's Beach, for reporting the presence af the roosts and for their co-operotion in allowing me access to the colonies, and also to Miss Margaret MacKean for the preparation of the figures.

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TABLE 1. BANDING AND RECOVERIES OF THE GREEN'S BEACH COLONY.

* Two pregnant females retained for captive studies.

DATE	*BANDED*	*RE-NETTED*	*TOTAL*
15:XI:1964	11*	-	11
20:XI:1964	3	1	4
28:XI:1964	6	6	12
TOTAL	20	7	27

TABLE 2. PROGRESSIVE MENSURATION GAIN IN *N. GEOFFROYI.*

Wt. = Weight in grams. T.L. = Total Length. T. = Tail.
E. = Ear. R. = Radius. P. = pes in millimeters.

Reg. No.	Sex	Date	Wt.	T.L.	T.	E.	R.	P.	Remarks
1964:1:292	♂	19:XI:1964	1.85	45	15	—	15	6	1 day old
1964:1:293	♀	19:XI:1964	1.13	41	14	—	12.6	6	" twins
1964:1:294	♀	19:XI:1964	1.45	43	13	—	14	6	" twins
1964:1:303	♂	28:XI:1964	2.39	51	16	13	18.5	7	
1964:1:5	♂	—	—	—	—	—	23.5	—	dessicated
1965:1:1	♂	29:XII:1964	5.78	78	32	22	36	7	flying
1964:1:6	♀	25:I:1964	—	—	—	—	38	—	
1964:1:290	♀	20:XI:1964	8.24	101	48	27	43	8.5	adult

No. 23

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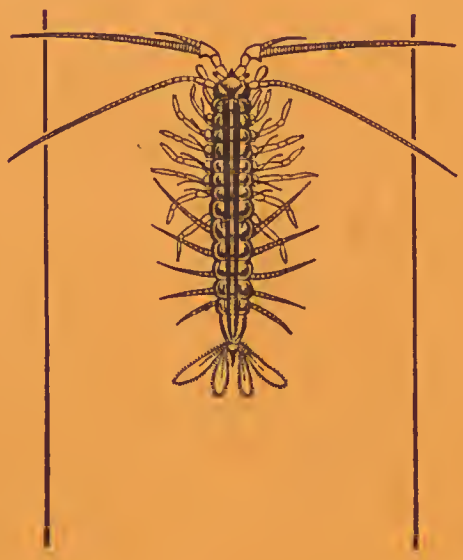

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FRENCH MANUSCRIPTS REFERRING TO THE TASMANIAN ABORIGINES

A PRELIMINARY REPORT

by

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University College, London

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Of the descriptions of the living Tasmanians, those by the voyagers who saw them before the settling of that island are the most complete. It can be said with some truth that these few travellers, whose observations cover only a few months of time, recorded as much or more of scientific value than the settlers occupying Tasmania during the seventy or so years that the aborigines survived among them, the one exception among the latter being George Augustus Robinson. This failure to observe arose from lack of interest in the natives : the settlers' one thought was to rid themselves of the aborigines, whom they considered anyway to be less than human. Even Joseph Milligan, who was both medically qualified and interested in the natural sciences, recorded little more than a vocabulary, yet he was in charge of the remnant of the people for more than ten years and had seen them in their natural state while a medical officer on the staff of the Van Diemen's Land Company.

The Pacific was the last great region of the earth to be explored by Europeans and, when its exploration became active during the second half of the 18th century, the surrounding lands were already well known and if not ruled by European powers, had European merchants controlling their foreign trade. Thus, the Spaniards firmly ruled the western shores of South America and were also established on the Pacific coast of North America and in the Philippines ; the Dutch controlled much of the East Indies ; and the British, the French and the Portuguese had various establishments on the Asiatic mainland.

When the great era of Pacific exploration began about 1760, the French and British competed for possession of the Pacific lands. Others had come either too early to consolidate their possession of the lands they discovered, as did the Spaniards to Fiji ; or too late, as did the Russians, for the French and British had already acquired everything worth having. In the Pacific, as elsewhere, the reason for geographical exploration was primarily trade, but to be able to trade in safety political influence had to follow in greater or less degree.

There was an important difference in emphasis in the conduct of the French and British expeditions : the making of observations in the natural sciences was of great interest to both nations, but while the British were content to rely on rather piecemeal methods for obtaining such information, the French made such research an integral part of the organisation of their expeditions and appointed special staffs to undertake it. Of all the British voyages to the Pacific in the late 18th and early 19th centuries, only those of Cook involved active participation by a national scientific body, the Royal Society, and even then few naturalists took part in the expeditions — Banks, Solander and the Forsters. There were other British voyages or explorations of which the naturalist was an important member (e.g. Robert Brown's association with Flinders), or which concerned the natural sciences (e.g. Bligh's expeditions to transplant the breadfruit tree) ; but these have to be contrasted with the well organised scientific work which was an integral part of the expeditions sent out by the French. Of course, because exploration meant the drawing of accurate charts and obtaining astronomical, meteorological and oceanographic information for the use of the seamen who would follow the routes later, the ships of both countries had well trained chart makers and nautical observers on board. But there the British largely let the matter rest. The technology of life at sea was of supreme importance, but science was something for the dilettante.

ORGANISATION OF THE FRENCH MARINE EXPEDITIONS

By the beginning of the era of Pacific exploration, the French had begun to organise their marine exploring expeditions along two very definite lines. Expeditions were perhaps primarily the concern of the navy, officers and crews being naval men, and the ships being supplied, equipped and provisioned by the navy ; but the scientific organisation of an expedition was no less important. In fact, the initial moves to promote an expedition seem to have been a combined approach to the administration from both the Institute of France*, which represented scientific interests, and those sections of government which were concerned with the advancement of political interests. And just as the navy had more or less a routine for equipping the vessels and appointing the officers and crews, so had the Institute and the Museum of Natural History in regard to the organisation of the scientific work.

The practical part played by the Institute and Museum was twofold. They recommended to the Minister of Marine the names of the savants who should be sent on an expedition, but they also planned the work these men should do. In the matter of appointments, at least of the more junior members, little was left to chance. The Museum seems to have recruited "traveller naturalists" from time to time (perhaps even annually). These were young men with knowledge of the natural sciences, having studied botany, zoology or mineralogy ; and perhaps having received their training in Paris, perhaps in one of the provincial centres. Those recruited were sent out with expeditions formed to explore by land or by sea, in junior positions at first ; and among them are to be found the names of many of those who were to become famous in one or other branch of natural

* In referring to the Institute of France I mean that body literally in the earliest years ; but gradually the responsibility was taken from the parent by the Museum of Natural History in Paris (which included the Jardin des Plantes).

science. There is a continuity in all this which is such an advantage in research : we find, for example, that the gardener Riédlé who died during the course of Baudin's expedition of 1800-1804, had already accompanied him as gardener on an expedition to the West Indies in 1796 ; and that La Haye, who was gardener on D'Entrecasteaux's expedition, had earlier been to Isle de France (Mauritius) where he had collected plants.

The other way in which the Institute was concerned in the planning of an expedition was in the organisation of a programme of work for each of the scientists, the various professors at the Natural History Museum and Jardin des Plantes drawing up their instructions and indicating what specimens were wanted particularly. It is only necessary to glance at some of the records to see what immense quantities of specimens were brought back to France from these expeditions.

Once appointed as members of an expedition, the scientists themselves appear to have selected the equipment they would be likely to need on the voyage, and this equipment was of such variety as to permit wide activities. Books and charts were also supplied, the books including not only the accounts of other travellers but also floras, monographs dealing with natural history, anatomy, chemistry and physics, mineralogy and so on.

MANUSCRIPT RECORDS RELATING TO THE EXPEDITIONS

The main object of the preliminary survey undertaken in 1965 was to locate manuscripts recording observations made in the field on the living Tasmanians, it being hoped that such records might contain details not found in the published accounts of the expeditions. Attention was directed to public records rather than to those in private possession, the former being the more accessible ; and those collections were examined particularly which seemed likely to contain observations made by the naval personnel or by the scientists accompanying expeditions which visited Tasmania before the era of British settlement, when the aborigines were in their natural state.

The records of these expeditions fall into two groups, the official naval records, and those of the scientists ; and while the naval records are generally complete, those of the scientists are very incomplete or are now lost. The relative completeness of the naval records is no doubt due to regulations which ensured that all journals kept by members of a ship's company were deposited in the official archives. Thus, on the voyage of D'Entrecasteaux journals of one sort or another were kept not only by the senior officers but also by the apprentices and even by some members of the crew ; and these are to be found in the naval archives. While many of the accounts deal only with details of weather and navigation, some describe events when the ships were at anchor.

With the scientists' records the situation was very different : once the results of the voyage had been written up and the specimens collected had been described, the original records were no longer considered of any value and were discarded. For any of the original records to survive would therefore be a matter of chance, even when the scientist had an official position in a museum or other institution, a state of affairs which is little different even today. The results of an intensive search for original scientific records are in accord with this view, and few relating to the voyages to be described hereafter have been located ,even among the archives of the Museum of Natural History in Paris, those found being incomplete and their subject and content quite unpredictable, worthless scribble being as likely to be preserved as material of the greatest value.

On the earlier expeditions, the association between scientists and seamen seems to have been very close, but by the time of the later expeditions their work was much more separate, that of the scientists having become so specialised technologically that it was now difficult for others to appreciate it. With the earlier expeditions, the shore parties engaged in exploration appear to have included both seamen and scientists, but on the later expeditions their visits to the land were largely independent. This means that the loss of the scientists' records can in some degree be made good for the earlier expeditions, but that with the later expeditions little information on scientific matters can be obtained from the records of the seamen. In anthropology, which did not become systematised until so much later than botany and zoology, there was little more than a recording of observations on the customs and productions of the various native races, so that any trained observer might be expected to notice somewhat the same things, and the differences between the records made by the scientists and the seamen would be likely to depend mainly on their relative opportunities for making observations. Thus, some of the more detailed naval records made during the voyage of D'Entrecasteaux were probably not very different from those of the scientists on board, and they can therefore be expected to yield information supplementing the published accounts, whereas in the absence of a close association between the two groups by the time of Baudin's expedition, much less supplementary information is likely to be forthcoming from the naval records.

THE FRENCH EXPEDITIONS VISITING TASMANIA

Marion du Fresne (1772)

Although Tasman had landed on the south-east coast of Van Diemen's Land in 1642 he did not see the natives — he found plenty of evidence that the place was inhabited — and the first Europeans to make contact with the Tasmanian aborigines were members of Marion du Fresne's expedition who visited Tasmania for a few days in March 1772, hoping to replenish their supply of fresh water and obtain spars for the ships. The vessels anchored in the same area as Tasman's had 130 years earlier. During the visit the voyagers met a party of natives. The meeting was at first amicable, but later relations changed, the natives attacking the French with spears and stones, who in response to this opened fire, killing one native and wounding others.

Marion's expedition differed very much from later French expeditions to the Pacific. In the first place, his expedition was largely a private commercial venture, being supported but not controlled by the government ; and in the second, the vessels were equipped and provisioned and the crews recruited at Isle de France. For these reasons, a scientific staff did not accompany the expedition. Government aid was obtained partly because the objects of the expedition were discovery and trade, and partly — and this was the official reason for giving support — because Marion du Fresne was to take back to his home a Tahitian named Pontaveri (Aoutourou) who had been brought to Isle de France by Bougainville in 1768 and was anxious to return to his own country. The expedition had only reached Isle Bourbon (Réunion) when Pontaveri became ill with smallpox, and he died shortly afterwards at Madagascar, where Marion had landed him. Pontaveri's death did not lead to the abandoning of the expedition : Marion decided to continue it in the hope of making useful discoveries.

An account of Marion's expedition was published in 1783 by Ronchon, an astronomer and member of the Institut de France, using the records of the expedition, and it is important to note that Ronchon had not accompanied it. Moreover, Ronchon could draw only on the information gathered by seamen, there being no scientists on board. This may not have led to many differences in a period when the natural sciences were still largely the province of the amateur and when anthropology in particular had not developed beyond the recording of casual observations, but at least there was a difference in outlook between the practical needs of the seamen and the disinterested scientific study of nature.

There are two series of documents dealing with Marion's voyage in the archives of the Ministry of Marine, and these include the journals of the principal officers of the two ships. From these accounts it is possible to build up a fairly detailed picture of what happened during the meeting with the natives. It differs to some extent from the account given by Ronchon, particularly in regard to the motives which led the natives to attack Marion's party, and it becomes clear that the latter was not attacked on account of any infringement of ceremonial on landing, but solely because the large number of French arriving from the ships led the natives to fear for their safety. The firebrand handed to Marion supposedly to light a ceremonial fire was one given him to warm himself, just as the seamen who had swum ashore earlier to help the landing from the boats were handed firebrands on reaching the shore, according to the custom of the natives.

From the descriptions of the natives generally, and from the report of the examination of the body of the native who was shot, some useful information can be obtained about the aborigines. In particular, the height of the dead man was measured (170.5 cm), and the colour of his skin noted (dark brown). The latter observation is of interest because something was done which few others did : the body was washed, so that the natural skin colour could be seen, unobscured by the charcoal and other substances with which the aborigines often bedaubed themselves, and by dirt.

D'Entrecasteaux (1792/93)

D'Entrecasteaux visited Van Diemen's Land twice during the progress of his expedition in search of La Pérouse, the first time being in April and May 1792 and the second in January and February 1793, spending altogether about ten weeks in south-eastern Tasmania. The scientific staff on the ships was impressive — five naturalists and two astronomers — not to mention the surgeons of the two ships, and two geographers (chart makers), two draughtsmen, and a gardener. Two accounts of the voyage were published, the more official one by Rossel an officer on the Recherche, and the other by Labillardière one of the naturalists. There is a great deal of archival material relating to this expedition, chiefly in the Marine archives, but also in the library of the Natural History Museum in Paris and elsewhere. The naval records are extensive and contain a number of the journals kept by the officers of the expedition, but, generally speaking, the records made by the scientists no longer exist.

A detailed analysis of these records has not yet been undertaken, but a few comments can be made at this stage. Some attention has been given to the medical records of the expedition, since it is now known that introduced European disease was an important factor in the extinction of the Tasmanians. During their stay the French had sufficient contact with the natives perhaps to transmit infection to them, so that by the time settlement began there may have been already a diminution in numbers of the aborigines due to epidemic disease. The medical records certainly show that there was disease of one sort or another among the crews of the ships, both acquired in France and in ports visited during the voyage — fevers, smallpox, dysentery and so on — but this by no means proves that it was transmitted to the natives, only that there was the opportunity for this.

Two sets of measurements on the living body are listed by D'auribeau, lieutenant de vaisseau on the Recherche. Unfortunately only one male and one female were measured, but the measurements are the only ones known apart from some made at the Flinders Island aboriginal settlement. Of course, others have measured stature (e.g. Marion du Fresne and Péron), but D'auribeau is the only one to give other measurements of the body.

Data have also been found on sex and age distribution among the members of a group of 48 persons, evidently a horde. The adults comprised ten men and fourteen women ; and there were twenty-four children. The excess of females over males should be noted, Labillardière also having observed a similar disproportion and found evidence for polygamy. However, the condition observed may not have been a normal one because where more than one female was associated with a male at a cooking fire, only one of the females seemed to be the man's wife, the other being ignored by him.

Other matters dealt with in the various journals are the customs of the natives ; their canoe-rafts ; vocabulary. It is clear that anthropological material was collected in Tasmania, but none of it is known to exist now. Piron's original drawings have been located : they show a number of details, particularly those of the adornment of the body, which are not clear in the published engravings.

Baudin (1802)

The third French expedition to visit Tasmania before 1803 was that led by Baudin. Again we find the detailed scientific planning and the large and competent party of savants — five zoologists, three botanists, two mineralogists and two astronomers — as well as two cartographers, artists and gardeners. The results of the voyage were edited by Francois Péron (completed after his death by Louis Freycinet), and the text was accompanied by a number of very fine plates based on the work of the artists Petit and Lesueur.

Archives of the Baudin expedition are to be found in a number of repositories, the most important being those in the Marine archives, in the library of the Museum of Natural History in Paris, and in the Museum of Natural History at Le Havre. Again we find that the naval records are much more complete than the scientists' records ; but here unfortunately it is not possible to fill the gaps in the latter with the observations recorded by the seamen. One gets the impression that while ships' companies and savants often visited the shore together during the D'Entrecasteaux expedition, they kept much more apart during the Baudin expedition. Moreover, the natural sciences had now developed so far that the scope of scientific observation was beyond the capabilities of the seamen, whose observations though exact were more superficial than those of the men trained in the natural sciences. Loss of a large part of the field records of the scientists means that there is less to fall back on in trying to make good deficiencies in the pub'ished record. Anthropological field data seem hardly to exist and the one hope is that detailed analysis of other

papers will bring to light information of value. A number of Péron's manuscripts are in the Lesueur collection at Le Havre, but few of them refer to Tasmanian anthropology (and the most important of these is badly mutilated). Another of Péron's anthropological manuscripts is in the library of the Faculty of Medicine in Paris but, like those at Le Havre, seems to be a draft for the published account of the voyage rather than an original field record. By far the most important anthropological material is the collection at Le Havre of watercolours painted by Petit and Lesueur (listed in the little known paper by Hamy, 1891), among which are several unpublished portraits and scenes.

Dumont D'Urville (1827/28)

Over twenty-five years elapsed between Baudin's visit and that of Dumont D'Urville in the Astrolabe, and by then there were no longer opportunities for studying the aborigines in their natural state. Moreover, the members of the expedition hardly went beyond the environs of Hobart, as was generally the case with later expeditions also.

The Astrolabe arrived at Hobart on 17 December 1827 and left on 5 January 1828. No reports of anthropological interest relating to this period have been found, either in the Marine archives or in the records of the scientific and medical staffs, but there is interesting material concerning the sealers and their Tasmanian native women whom the visitors had met in November and December 1826. At King Georges Sound (Western Australia) a vocabulary was obtained from one of these women, a native of Port Dalrymple, and part of the original of this has been found in the Marine archives. This contains some differences from the published vocabulary, and of course not all the words are Tasmanian but some had an external origin.

A Tasmanian cranium brought back by the expedition is now in the collections of the Musée de l'Homme (Reg. No. 972).

Laplace (1831)

Laplace reached Hobart in the Favorite on 8 July 1831 and left a month later, on 7 August. There are no reports on the living natives, and at this time there may not even have been any captives in the gaol at Hobart. However, Eydoux the surgeon may have seen one ill in the colonial hospital, because one of the trophies of the visit was the preserved head of an aboriginal, which was probably obtained from the hospital. This head was described superficially by Dumoutier in 1874 and by Gervais in 1876, but it had by then deteriorated to such an extent through faulty preservation that a detailed examination was no longer possible ; only the skull remains, in the Musée de l'Homme (Reg. No. 3637).

Two Tasmanian crania were also brought back to France, and are now in the collections of the Musée de l'Homme (Reg. Nos. 3619, 3638).

Dumont D'Urville (1839/40)

Dumont D'Urville paid a second visit to Hobart twelve years after his first, this time with the two vessels Astrolabe and Zélée. The ships reached Hobart on 12 December 1839, left to explore in antarctic seas on 1 January 1840, returned to Hobart on 17 February and on 25 February sailed from there for New Zealand. There had been much sickness on board the ships and the visits were largely occupied with tending the sick and with convalescence. As a result, members had little time for excursions, and certainly did not go to Flinders Island where all except a few "tame" natives were living. Among the exceptions were probably two native children attached to Sir John Franklin's household, the girl Mathinna and a boy named Timmy or Adolphus.

The medical staff included Dumoutier, and though very fully occupied with the sick he was sufficiently interested in the natives to make collections. Dumoutier spent a great deal of time during the expedition in modelling busts of the natives he saw at various places visited, and busts of several Tasmanian aborigines are among those brought back by the expedition and now in the Musée de l'Homme. In the official reports it is stated that several busts of Tasmanians were modelled from nature by Dumoutier and two others obtained by purchase. The latter were the well known busts by Law of Trugernanna and Woureddy ; but the statement that the others were modelled from nature by Dumoutier is clearly not correct, because one of those portrayed (Mannalargenna) had died about five years earlier, and some at least of the others are likely to have been associated with G. A. Robinson and to have been either with him at Port Phillip or at the Flinders Island settlement at the time of Dumont D'Urville's visit to Hobart. There is pretty clear evidence from Dumoutier's manuscripts that these other busts were in fact copies of some in Sir John Franklin's collection. Great interest was taken in this collection by the visitors ; and some of the portraits of the aborigines which Sir John had obtained from Thomas Bock were sketched and their annotations recorded, making it possible to identify with certainty the series of portraits by Bock now in the Pitt Rivers Museum (Oxford) as having belonged to Sir John.

The voyagers also obtained a fine collection of Duterrau's engravings, probably from Duterrau himself as some annotations on them suggest ; and they may also have met Thomas Bock, the collection brought back to France having contained a pencil sketch by him of an aboriginal. Four crania were also obtained in Hobart, but only three of these were Tasmanian (Reg. Nos. 973, 4767, 4768), the fourth being that of an Australian aboriginal who had died in the hospital at Hobart (Reg. No. 4766). This Australian aboriginal skull was illustrated in the official publication dealing with the voyage, and designated there as that of a Tasmanian ; and was also included by Broca among his measurements of Tasmanian skulls.

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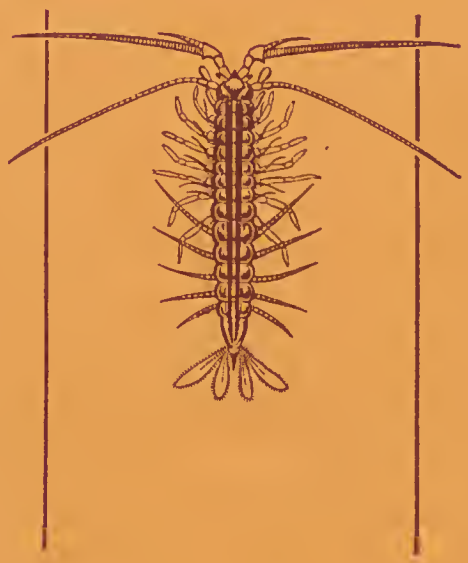

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A SUMMARY OF PUBLISHED WORK ON THE PHYSICAL ANTHROPOLOGY OF THE TASMANIAN ABORIGINES

by

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THE SKELETON

Studies of the skeletal morphology of the Tasmanian aborigines suffer largely from two restrictions. In the first place, the amount of skeletal material available for study is very small, and in the second, particulars as to the origins of it are known certainly in very few instances. Add to these the difficulties arising from the wide dispersal of the collections, about half being in Europe and the United States and half in Australia, and it will be realised that it is not easy to arrive at a clear picture of the characteristics of and range of variation in the Tasmanian skeleton.

Skeletal material in European collections comprised, at the beginning of 1939, five complete skeletons, about eighty skulls, a pelvis and a few long bones: in the war of 1939 - 1945 three skeletons, thirty-five skulls and the long bones were destroyed, all this except one skull being material in the Royal College of Surgeons of England (Plomley, 1962). In Australian collections there were, in the same year, one hundred and fourteen skulls considered either then or earlier to have been Tasmanian (Wunderly, 1939); as well as one complete and one nearly complete skeleton, and a number of separate bones, largely those from the limbs, most of which were in the collections of the Tasmanian Museum at Hobart (Crowther and Lord, 1921). In the United States, published information suggests that there is only a small number of skulls, perhaps a dozen, in national collections, of which three had earlier been in one of the British collections.

The provenance of these collections of skeletal material is far from satisfactory, and as a result there has been (a) discussion of the validity of this specimen or that, which has taken place in regard to the Australian collections particularly; (b) the development of a description of the Tasmanian skull from specimens which conform most closely to the series of characters, metrical and non-metrical, held to be typically Tasmanian, rather than from the study of skulls known to have been those of Tasmanian aborigines; and, arising out of the foregoing, (c) abnormally low values for variability in the data, and a failure to appreciate fully the range of variation in the characters of the race (Morant, 1939).

It is not to be wondered at that such discussion has arisen. Thus, of the crania listed by Plomley (1962) as being in European collections, about seventy have no locality data other than "Tasmania"; and of those for which a more restricted locality is given, there is sometimes doubt whether the locality data are correct, the examination of other records opening up other interpretations.

It may be well here to emphasise certain facts about the Tasmanian locality as a source of skeletal remains. The most important fact is that there are no known aboriginal burial grounds in Tasmania: most of the tribes practised cremation, and those which did not disposed of bodies haphazardly. So far as known all crania in collections are those of aborigines dying after 1803 when the island was first settled and, although dates are not given, the names of collectors, when recorded, suggest that collecting did not begin before about 1820.* The collecting data also show that acquisitions ranged from specimens obtained in such circumstances that there was little or no doubt as to their authenticity, to those acquired without other evidence of their origin than finding in Tasmania.† Material in the latter category must always be doubtful: from the time of the first settlement (and probably from a few years earlier, if we take account of the sealers) there was a mixture of races in Tasmania, and hybrids originating in the prostitution of the native women were also to be found. Among those coming to Tasmania were negroes, polynesians, asiatics, and of course Australian aborigines. Under these conditions the perils of collecting are obvious. Thus, we find a skull described as Tasmanian because it had been collected in Hobart (Blanchard, 1854), but which was found later to have been that of an Australian aboriginal (Quatrefages and Hamy, 1882); and material in the "Tasman series" has been classified as hybrid because it did not fit the narrow confines of supposed morphology (Wunderly, 1939). Lastly, it is worth emphasising one point about the graveyard of the aboriginal settlement at Flinders Island, from which skeletal remains have been removed: not all the burials there were those of Tasmanian full-bloods.

* Except perhaps for one skull, no skeletal remains were brought back by the exploring expeditions which visited Tasmania before it was settled.

† Such was the avidity of some collectors to possess the skull of a Tasmanian aboriginal that it was sufficient for it to be labelled "Tasmanian".

THE SKULL

The description of the Tasmanian skull has its basis in an assessment of the characters of a group of skulls said to be Tasmanian. This assessment has then been used as the basis of classification of other skulls, designating them as Tasmanian or not according to whether

they do or do not possess those features considered to be characteristic of the Tasmanian skull. This is no less than circular argument : a series of characters is laid down as Tasmanian on the basis of the examination of skulls believed to be Tasmanian, and this yardstick is then used to classify other skulls, both those said to be Tasmanian and those not so labelled. It is obvious that while such a method will classify as Tasmanian a group of "typical" skulls and do so fairly definitely, it will certainly not enable us to select all skulls which are Tasmanian and reject all those which are not. What has been done by this method of procedure is to select the group of skulls whose characters are close to mean values, but to reject those whose characters lie outside this range ; and as different workers have set the limits of the range of variation at different points, discussion has arisen as to the status of this skull or that.

It is generally agreed that the Tasmanian skull shows a distinctive assemblage of characters, the definition of which has gained precision with the work of Turner (1908, 1910). However, description of the Tasmanian skull has tended to suffer from the fact that no one person has examined all the material available, something which would be of value in view of the small number of crania available for study. Generally speaking, Austra'ian workers have not examined the European collections, nor European workers the Australian series.

The non-metrical characters of the Tasmanian skull have been reviewed by Turner (1908, 1910), by Wunderly and Wood Jones (1933), and by Wunderly (1939). These authors have drawn attention to the distinct frontal eminences, prominent parietal eminences and approximately pentagonal form of the vault, with keeling along the line of the sagittal suture, especially anteriorly. Between the obelion and the lambdoid suture the surface of the vault is flattened. The glabella and superciliary ridges are strong in males, overhanging the orbits, and the nasion is deeply depressed. The nasals are short and narrow. The floor of the nose continues smoothly into the incisive area and is not separated from it by a sharp ridge. The anterior nasal spine is poorly developed. The width of the anterior nares is at least half their height and sometimes much wider. The orbital aperture is transversely elongated (rectangular) and relative'y low. The hard palate is shallow rather than deeply vaulted. The styloid process is small to rudimentary. Sutural bones occur commonly in the occipital area (84% of skulls in one series). The mastoid processes and inion are not massive ; the superior nuchal line is sometimes prominent and divided into upper and lower parts.

The principal workers in Australia who have published studies of the Tasmanian skull are Berry and his co-workers (1909, etc.), Harper and Clarke (1898), Wood Jones (1929), and Wunderly (1939). Their work has been reviewed by Wunderly (1939) who examined the whole of the Australian collections then known. Wunderly dealt with 114 crania, complete or fragmentary, which had been designated Tasmanian at one time or another. Of these he considered there to be :—

Tasmanian full-bloods — 31 ♂♂, 27 ♀♀, 2 ⊙⊙, 7 mandibles	67
Tasmanian-European hybrids — 1 ♂, 6 ♀♀	7
Tasmanian-Australian hybrids — 2 ♂♂, 7 ♀♀	9
Australian full-bloods — 4 ♂♂, 6 ♀♀, 1 ⊙, 1 mandible	12
Australian-European hybrids — 3 ♀♀	3
Of unknown race, lost or fragmentary	16

Wunderly gives metrical data for most of the Tasmanian full-bloods (31 ♂♂, 27 ♀♀) and Tasmanian-Australian hybrids (1 ♂, 7 ♀♀). In the absence of metrical data for the other specimens and especially for those classified as hybrids, it is not possible to arrive at an opinion as to whether Wunderly has been too strict in his selection of Tasmanian skulls, as his standard deviations suggest (Morant, 1939) ; but there are other grounds for debating some of the conclusions reached in this paper and in that on the aborigines of the west coast of Tasmania (1938). These are :—(a) there do not seem to be any grounds for attributing the skeletal material collected at Eaglehawk Neck (Lord, 1919) to an early occupation ; (b) neither the collecting data, nor the history of hybridisation in the Bass Strait region from the time when the islands were occupied by the sealers, support the view that hybridisation between Tasmanian and Australian aborigines was anything but of rare occurrence — for eight skulls of such composition to be found along the north-west coast of Tasmania, 15% of the Tasmanian crania in his series, seems incredible ; and (c) much of the evidence presented in support of the view that the aborigines of the west coast were culturally and morphologically distinct from those of other areas is of doubtful validity, but if a supposed Australian type occupied the region, as Wunderly concludes from an examination of the skull, then it must be accepted as a local variant within the range of Tasmanian morphology.

Tasmanian crania in collections in Europe have been examined by a number of workers — Barnard Davis (1867, 1874, 1875), Flower (1879), Garson (1899), and Turner (1908, 1910) ; Basedow (1910), Klaatsch (1903, 1908), and Pöch (1916) ; Broca (1879), Quatrefages and Hamy (1882), and Topinard (1872). Metrical data have not been published for all these crania, nor have their non-metrical characters been analysed. In almost all collections there are some crania not yet described and measured ; metrical data on the crania of the Royal Army Medical College and of the British Museum series have not been published ; and the crania in Paris are largely referred to in terms of means of groups of them.* It should be noted also that the skull in Vienna described and measured by Pöch is No. 3 of the Harper and Clarke series and has also been described and measured by the latter authors. Morant (1927) has reviewed all the metrical data published for Tasmania crania in European collections, as well as the Harper and Clarke (1898) measurements and those of Berry, Robertson and Buchner (1914).

* Broca's individual measurements of the Paris skulls have now been found. An Australian skull is included among the males.

DENTITION

Very little information is to be obtained from the literature* concerning dental characters in the Tasmanians. The teeth are megadont, and the dental arches well developed.

* Steadman (1937) has provided descriptions of the dentition in crania in collections in England, including those in the Royal College of Surgeons which are now destroyed.

Steadman (1937) had directed attention to the marked attrition found in the teeth, and to malocclusion resulting from this ; and to a number of cases of impaction, usually of the upper third molars, with crowding due to the large size of the molar teeth. He also noted that there was very little periodontal disease and dental caries.

However, no detailed study has been published on the teeth and alveolar arches in the Tasmanians, on the lines of the well-known study by Campbell (1925) on the Australian aboriginal.

Although it has been suggested that tooth avulsion was practised by the natives, a review of supposed cases suggests rather the haphazard loss of teeth by injury.

AXIAL SKELETON

Except for some measurements of femora by Wunderly (1939) and by Abbie (1964), the only work on the axial skeleton refers to the five complete skeletons and a pelvis in European collections prior to 1939. Garson has reviewed most of this work.

The lumbar curve was first studied by Cunningham (1886) who found that the sum of the heights of the bodies of the lumbar vertebrae was greater posteriorly than anteriorly in all except the fifth, giving lumbo-vertebral indices of 108.5 in the two males examined and 104.7 in the female. A general lumbar index of 101.6 was found in the male measured by Turner (1910). This is the opposite to the condition in Europeans, where the greater height of the lumbar bodies anteriorly contributes significantly to the lumbar curvature.

Some particulars of vertebral structure have been given by Turner (1910) for the skeleton in Brussels. The spinous processes of cervical vertebrae 3 - 7 were non-bifid in the three skeletons examined by Cunningham (1886 ; C3 - 5 slightly bifid in one skeleton), and in the Brussels skeleton (Turner, 1910).

Some notes on the ribs and sternum of the Brussels skeleton are given by Turner (1910) ; and notes on the thorax by Garson (1899).

APPENDICULAR SKELETON

Measurements made on the four skeletons in Britain, three of which are now destroyed, have been published by Barnard Davis (1874), by Garson (1899), and by Klaatsch (1903) ; and a series for the Brussels skeleton by Turner (1910). Unfortunately, Barnard Davis' measurements contain mistakes, apparently arising in the calculation of millimetre equivalents for his measurements in inches : some of these mistakes are large. Garson examined the same material but he gives only a few individual measurements (and there is one large, though obvious, mistake), so that there is no check on Barnard Davis' measurements ; moreover, several of the measurements do not correspond. Thus, Garson states that the radius in the female measured 214.5 mm and Barnard Davis 234 mm. Under these circumstances many of the measurements made by Barnard Davis and by Garson are of doubtful value.

The limb bones of the Tasmanians are generally robust, in this character differing markedly from those of the Australian aborigines.

UPPER EXTREMITY

Scapula

The scapula in the Tasmanians shows unusual characters, being short in proportion to its breadth, so that both the scapular and infra-spinous indices are lower than in Europeans and many other races, e.g. Australians and Andamanese (Garson, 1899 ; Klaatsch, 1903 ; Turner, 1910).

Radius and ulna

In view of the difficulty in reconciling the measurements made by Barnard Davis and by Garson, only Turner's measurements can at present be used. In the Tasmanians the forearm is longer than the upper arm in comparison with Europeans, the Tasmanians resembling in this character the Australian aboriginal.

LOWER EXTREMITY

Pelvis

The pelves in British collections (3 ♂♂, 1 ♀) have been described by Barnard Davis (1874), and by Garson (1899) ; that of the male skeleton in Brussels by Turner (1910) ; and a separate male pelvis in Paris by Verneau (1875), and by Garson (1899).

In the four males, Garson found the antero-posterior diameter of the brim to be almost the same as in the European, but the transverse diameter to be less, giving a pelvic index of 93.1 in the Tasmanians as compared with 78.3 in Europeans. The infra-pubic angle, about 60°, was more acute in the Tasmanian pelves than in European. Turner found the Brusse's specimen to be exceptional in regard to the above measurements.

The size and shape of the greater sciatic notch, which is usually one of the most valuable guides in sexing, is about the same in male and female Tasmanians (Abbie, 1964).

The sacrum was relatively narrower than in Europeans in Garson's specimens but the reverse was found by Turner in the Brussels specimen.

Femur

A detailed description of the femur, as well as of the tibia, in the Brussels skeleton, has been given by Turner (1910). Some measurements on the skeletons in Britain have been given by Barnard Davis (1874), and by Garson (1899) ; and measurements on femora and tibiae in Hobart by Wunderly (1939), and by Abbie (1964).

Turner found the neck of the femur to be short, the trochanters well developed and the linea aspera prominent, with the middle third of the shaft triangular in section. The platymeric index was less than in Europeans.

Tibia

In the Brussels skeleton Turner found the shaft to be laterally compressed, and the anterior border strong and somewhat falciform. The head was retroverted. "Squatting facets" occurred at the lower end of the shaft and on the malleolus, in association with anterior articulation with the talus, which had corresponding articular facets on its neck.

Foot

Turner has described the foot in the Brusse's skeleton. He points out that the tarso-metatarsal articulation for the hallux would permit a wide range of movement there, and draws attention to the habit of the Tasmanians of grasping the spear between the great and second toes.

STATURE

Information on stature in the Tasmanians comes from three sources :—

(a) Statements based upon visual estimates.
(b) Estimates from the skeleton, or from femur and tibia.
(c) Measurements of the living people.

Statements based upon visual estimates are of doubtful value. At best they indicate that a native was taller or shorter than the observer, or about the same height. In many cases the emotions (fear, etc.) probably conditioned the estimate. Even so, these estimates give no suggestion that the Tasmanians were a pygmoid people, or even that they were particularly short.

Estimates of stature based upon measurements of the entire skeleton (Barnard Davis, 1874 ; Garson, 1899 ;

Turner, 1910), suffer from the defect that soft parts must be allowed for; while those based upon the lengths of femur and tibia also need to take account of the proportion of these parts relative to the total stature. Garson, after allowing for soft parts, estimated stature from the four skeletons in British collections as having a mean value of 1661 mm (5' 5½") for the three males, and 1422 mm (4' 9") in the female; Turner estimated a height of 1572 mm (5' 1½") from the male skeleton in Brussels. Wunderly, calculating from measurements of a series of femora and tibiae, arrived at a mean value of 5' 5" (1651 mm); but he does not state whether he made allowance for the greater relative length of the lower limb in the Tasmanians. Abbie (1964) measured three femora which indicated statures of six feet or more.

There are few measurements of stature on the living aborigines. In 1772 Marion du Fresne measured the body of one man and found the height to be 5' 3" (old French measure = 1705 mm); in 1792 one of D'Entrecasteaux's officers measured two natives, the male being 1705 mm and the woman 1638 mm; and in 1802 Péron measured fourteen natives (? males) and found their average height to be 1705 mm. About 1836 G. A. Robinson measured a number of the captive natives on Flinders Island, obtaining mean values of 5' 3¾" (1618 mm) for twenty-three men and 4' 11½" (1503 mm) for twenty-nine women (Barnard Davis, 1874; in 1875 he stated that these measurements were made on 25 men and 25 women), but a preliminary re-examination of Robinson's data has indicated that the means for both sexes were probably too low. Moreover, there are inconsistencies in Robinson's measurements which will make necessary a careful study of the whole series to determine their reliability.

In view of the lack of precision in some of the measurements and most of the estimates of stature, it can only certainly be said of the Tasmanians that they were not pygmoids, and that they were probably nearly as tall as the "average" Australian aboriginal. This is all very vague and imprecise, but then so is a large part of the data upon which statements have at present to be based. The idea that the Tasmanians were pygmoids probably arose in theories deriving them racially from the Oceanic negritos, but does not seem to have been supported by actual measurements of stature.

There is a fair amount of information concerning stature now available in manuscript accounts of the natives, and a rigorous analysis of this is urgently needed. If to this sort of information is added that determined from measurements of femur and tibia, stature in the Tasmanians will be determinable with much greater precision.

PROPORTIONS OF THE BODY

Garson (1899) and Turner (1910) have pointed out that the lower limbs were relatively longer in the Tasmanian aborigines than in Europeans, a condition found also in the Australian and some other races. Garson and Turner based their statements on skeletal measurements, none having been published on the living subject.

THE HAIR

In the Tasmanians the hair of the scalp and beard formed into tightly coiled spiral locks which apparently could be as long as about six inches. The women wore their hair short, the men long. There are no satisfactory reports of any variation in the character: the few specimens of straight or wavy hair in museum collections which are labelled as Tasmanian are not likely to be so. The "blonde" hair described by Pöch (1916) was thought to resemble the artificially decolourised hair of the melanesians; but possibly it was of hybrid origin.

The coiled hair of the Tasmanians was the subject of comment by nearly all those who saw them. It was first described by Pruner-Bey (1864), and later by Friedenthal (1913), von Luschan (1911), and Turner (1914). The hair is ovoid in cross-section, the ratio of the two diameters giving an index of about 65; the shaft is twisted on itself at intervals.

Preliminary work (Plomley and Baldwin, 1964; Plomley, unpublished) indicates that the form of the hair follicle, and perhaps the arrangement of the follicles, may be characters of diagnostic importance. The form in the Tasmanians apparently resembles that found in certain negritic peoples.

FACE AND EXTERNAL EAR

Generally speaking, descriptions of the face in the Tasmanians emphasise that the nose was broad and the nostrils distended, the mouth wide and the eyes deeply set; and sometimes a resemblance was found to the features of the negro. Most of the descriptions are very subjective.

Comments made by G. A. Robinson in his journals (Plomley, 1966) make it clear that a fairly wide range of facial form occurred, some natives having thin lips and narrow nose. The same impression is gained from portraits.

Although the number of portraits of the Tasmanians is limited, it will probably be worthwhile to analyse them metrically. The portraits available comprise photographs, paintings in oil and watercolour, pencil sketches, busts and face masks. Their scientific value differs a great deal: the photographs are exact, but are of middle aged or old people who had lived for many years out of their natural environment; the paintings, sketches and busts, though often of young people in their natural state, have usually been europeanised in some degree either by the artist or during the processes of copying for reproduction, or both original and copy suffer from such defects. Before using each portrait it will be necessary to examine its history with care: some are known to be copies of other portraits, others are likely to be copies, and still others probably originated largely in the notions of the artist. Even so, careful selection is likely to leave a sufficient number for an analysis of facial characters.

No work has been published on the external ear in the Tasmanians, but bearing in mind the above comments on the status of the various portraits, a metrical analysis based on the photographs and some of the portraits should produce some information of value.

PIGMENTATION

The records available, both written and pictorial, lead to the conclusion that skin colour varied in the Tasmanians from reddish-brown to black.

BLOOD GROUPS

Some data on the ABO and MN blood groups have been published for Tasmanian - Australian - European hybrids by Birdsell and Boyd (1940), and are thought to indicate racial relationships between the Tasmanian and Australian aborigines, but the conclusions reached as to the racial derivation of the hybrids are probably less certain than the authors believed.

It would seem worthwhile, however, to attempt to extend such studies on the Bass Strait "halfcastes" to hybrid Tasmanian families or groups living elsewhere in Tasmania and Australia.

COMMENTARY

Future studies on the morphology of the Tasmanians will need to consider in the first place the authenticity of the material examined. Precision can only be obtained in morphological studies if the material studied is of known origin, and to this end specimens must be eliminated from a series which are not those of Tasmanian full-bloods, and those included which, though atypical according to present ideas, have been derived from full-bloods. Whatever the future may hold in the way of new methods of identification, the only means at present known is to trace each specimen as far back towards its origin as may be possible, but in spite of the tediousness of such a search and the lack of success likely in very many instances, this procedure may be expected to validate a sufficient number of specimens as a basis for precise group data.

Studies of the skull particularly will benefit from this procedure. To compare satisfactorily the Tasmanian skull with those of other groups, it is essential to have as a basis for comparison a group of skulls known to have been those of Tasmanian full-bloods,* or which are indicated by the collecting records as likely to have been those of full-bloods. Such a sample, based on origin rather than on morphology, is likely to be more indicative of phylogeny, even though characters now thought to be typically Tasmanian may lose some of their definiteness as the range of variation is widened. It is, of course, highly desirable for one craniologist to re-examine all the Tasmanian crania now existing, and this review of the collections should cover those located in Australia and overseas, both in Europe and the United States. Pending such new work on the Tasmanian skull there seems little point in rehashing the literature on the subject.

* A major disadvantage in work on the skull (and skeleton) in the Tasmanians is the small amount of material available for study. Attention might be directed to the possibility of obtaining more by the excavation of graves of known full-bloods, both in Tasmania and on the islands of Bass Strait.

The principal object of study of the Tasmanian skull has always been to try to ascertain the racial relationships of this people. From such studies most workers have concluded that the Tasmanians are more closely related to the Australians than to any other group, even if the notions of the racial composition of the Australians have differed among the different investigators. There has been some disagreement as to the particular population of Australian aborigines to which the Tasmanians are most closely related, but this would seem to reflect little more than the incompleteness of our knowledge of variation in cranial form over the Australian continent, a lack which can only be made good by detailed studies on crania from restricted regions (e.g. Freedman, 1964).

Some workers, however, have found closer relationships between the Tasmanians and the Papuans than between the Tasmanians and the Australians, but just as comparisons between Tasmanians and Australians suffer from lack of knowledge of cranial variation in Australia, so do the comparisons between Papuans and Tasmanians from incompleteness of the Papuan series. In this regard, attention is directed to the work of Genet-Varcin (1951), who came to the conclusion that the Tasmanians had not descended from negritos but only from the same melanodermic stock.

Studies of cranial form made with the object of elucidating racial relationships, have two difficulties to overcome: firstly, to what extent can it be expected that racial relationships will express themselves in cranial form; and secondly, knowing the very large modifications of cranial form which can be produced by the environment, will racial relationships be concealed thereby? The first problem is partly a genetic one and partly a problem of recognition. It amounts on the one hand to the question whether genetic differences will express themselves in distinct morphological differences in the skull, and on the other hand to the recognition of such differences and their phylogenetic trends. It must be admitted that the study of craniology has had its successes mainly in the field of palaeontology, and that in its application to the analysis of racial relationships among modern men it has been far less successful. Perhaps interbreeding and the range of variation in man renders the idea of races untenable in practice however justifiable it may be in theory in relation to isolates. This, of course, does not mean that craniological studies will not reveal differences between populations, differences which are greater the longer the group has been isolated; but such studies will not necessarily point to racial relationships, for even when similarities can be made clear by precise studies of variation, there still remains the possibility that similar environments may be more important in the production of similar form than is common descent. It must also be remembered that racial relationships can only be soundly based if resting upon more than one group of hereditary characters, and where others are known the several groups must be reconciled. With the Tasmanians this has raised difficulties, for in comparing them with the Australians there has been the need to explain the occurrence of ulotrichous hair in the Tasmanians.

To summarise the present position in regard to the ancestry of the Tasmanians, those who hold the view that they were related to the Australian aborigines have to explain the universal (?) occurrence among them of ulotrichous hair (and its absence among the Australian aborigines), while those who consider the Tasmanians to be "negroids" must explain the skeletal and cultural similarities between Australians and Tasmanians. Examination of the problem in terms of population genetics is likely to be rewarding.

In future studies of the Tasmanian aboriginal, there is a good case for analysing the characteristics of crania of known Tasmanian-European hybrids*. By so doing it is possible not only that some understanding will be gained of the effects of racial mixture on the skeleton, but that an insight will be obtained of the nature of those characters of the hybrid which are Tasmanian in derivation.

* It is indeed strange that such a study has been neglected, in spite of the difficulties in obtaining known hybrid material; but the neglect is even less understandable in the case of the Australian-European hybrid, where not only are there good opportunities for its study, but it is a matter of some importance in relation to problems of assimilation between the two races.

Apart from the study of the long bones in relation to estimates of stature, it would seem that work on other parts of the skeleton than the skull is not likely to produce much of value. Although very little is known about skeletal morphology in the Tasmanians, the amount of material available for study is so minute (now only about three complete skeletons!) that it is not even possible to say whether normality or abnormality is being observed.

Finally, attention should be directed to the effects of disease and malnutrition on the skeleton in their relation to its morphology. There are some pointers in the literature to such effects : for example, the body habitus of some of the natives sketched by Lesueur in 1802 ; and the comments by Dumont D'Urville in which the well nourished bodies of the sealers' women are contrasted with those of natives occupying the natural environment. No X-ray examination of the Tasmanian skeleton has so far been undertaken to study the effects of disease and malnutrition on it.

It is clear, therefore, that at present there are few studies which can usefully be made in the subject of physical anthropology in the Tasmanians. Satisfactory techniques have not yet been developed for the determination of blood groups in skeletal and mummified remains and until such time as they become available material should not be destroyed unnecessarily. For the future also must be kept chromatographic studies of the body fats, which it may be possible to undertake on hybrids or perhaps on skeletal or mummified material. Nothing is known of finger, palm and sole prints in the Tasmanians, and anyway the rarity of mummified parts is such that no result of significance could be expected. Altogether, the scope of future work is likely to be confined to those few subjects for investigation mentioned above, until such time as new techniques make possible new researches.

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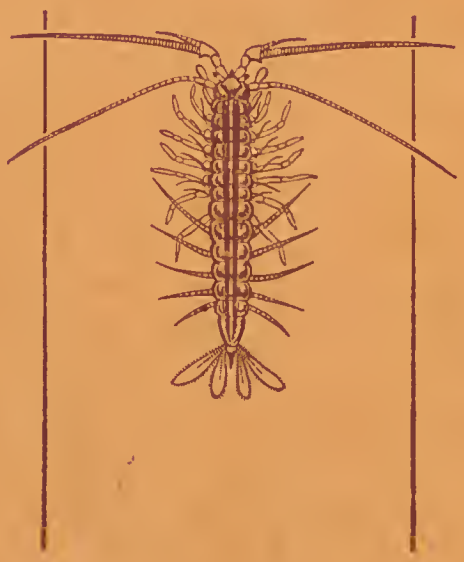

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A SPECULATIVE ARCHAEOLOGICAL SEQUENCE FOR NORTH-WEST TASMANIA

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This paper was presented to the General Meeting of the Australian Institute of Aboriginal Studies, Canberra, on 19 May, 1966 and is a development of two papers given at the A.N.Z.A.A.S. Congress at Hobart in August, 1965.

Tasmania is a mountainous island peripheral to the Australian land-mass, and it is in that direction that we must look for most of the physical and biological relationships (Darlington 1960, p. 659; Jackson 1965, p. 30). On the other hand, many elements of the environment reflect its southerly position, and there are similarities between the west coast of Tasmania and other southern temperate regions such as the South Island of New Zealand, and the west coast of southern Chili.[1] If man came to Tasmania from the Australian mainland, it would be interesting to see, in the archaeological record, what cultural changes occurred in response to the new conditions and also what were the effects, if any, of isolation on prehistoric man and his cultures on the island.

In the last sixty years, there has been a great deal of archaeological work carried out in Tasmania, but most of this has been concerned solely with the amassing of surface collections, and field observations of the sites themselves were rarely recorded. Apart from Meston's work at Rocky Cape, there was no attempt made at excavation. Most of the literature consists of general typological descriptions of stone tools (Noetling 1907, 1910 *b*; Klaatsch 1908; Balfour 1925, 1928; Legge 1929; Meston 1937*b*; Mitchell 1955), or of speculations concerning the cultural status, origin or antiquity of man in Tasmania (Tylor 1894; Noetling 1910*a*; Sollas 1911; David 1924; Pulleine 1928, pp. 296-309; Wood Jones 1935; Meston 1937*a*; Davidson 1937; Tindale 1937, pp. 34-36, 1957 p. 11; Taylor 1950). Mulvaney outlined some of the problems of Tasmanian prehistory (1961 pp. 95-99), and Macintosh and Barker (1965 pp. 1-55) have reviewed the extensive literature on Tasmanian physical anthropology. The standard account of the ethnographic literature has for a long time been that of Roth (1899), but the publication of Robinson's diaries (Plomley 1966) together with new problems posed by archaeological research, calls for a re-analysis of this material. New studies on Tasmanian ethnography have been made by Kemp (brief account in 1963) and Hiatt (1965).

A distribution map of surface collections (Bryden and Ellis 1965) shows that there was prehistoric occupation on all parts of the coastline. The relative paucity of collections from the south west is probably a function of the inaccessibility of the area to collectors. Inland, there are many surface sites in the midlands and in the Derwent Valley; and artifacts have also been found inland from the east coast, in the highlands around the Great Lake, and near the head waters of some of the north coast rivers. This distribution pattern corresponds well with the map compiled by Hiatt (1965, maps 1 and 2, ff. p. 122) of the locations of direct ethnographic observations on the aborigines, and the similarity of prehistoric and ethnographic patterns suggests that the geographical range of the population had been established for some time. Kemp (1963, p. 243) has suggested from her study of surface collections that there are significant differences between assemblages from the west coast, the east coast and midlands, and the Great Lake areas. There may be chronological as well as spatial factors involved here.

The areas not occupied by the aborigines coincide closely with the distribution of the temperate rain forest (Davies 1964, p. 251). Several authors (Gilbert 1959, p. 143; Davies 1964, p. 252; and especially Jackson 1965, p. 33) have shown that fire frequency is an important ecological factor in the relationship of rain forest, wet sclerophyll and sedgeland forms. Jackson says that "where the frequency of fires is high the forest is replaced by open communities of sedgeland and wet scrub with boundaries of wet sclerophyll". Much of the extensive sedgeland on the west coast is believed to be pyrophytic, the disclimax state having been created and maintained by intense aboriginal fire pressure. The sedgeland would have been a much richer hunting and collecting area than the rain forest, which "is distinguished by its stillness and lack of conspicuous life" (Guiler 1965, p. 37). Penetration through the rain forest would have been effected by use of fire-maintained routes or a chain of 'plains' as described by Hellyer at Surrey Hills in 1827 (Meston 1958, p. 40), or by Robinson at the important ochre mines near Mole Creek (28 April, 1832; 16 July, 1834). Stone tools have been found at such small open grasslands in southern Tasmania (Ridpath 1964, p. 347).

1. There are similarities in climate, littoral ecologies (Knox 1960), temperate rain forest flora (Godley 1960; Jackson 1965, p. 33) and sea mammals (King 1964, pp. 23, 78).

At first sight, there seems to be a great dichotomy between the distribution of occupation on the east and west parts of the island, and this has led some authors including Kemp (1963, p. 243) to postulate marked differences in the diet and movement of peoples on the two coasts. Hiatt (1965, pp. 62-65) tabulated the frequencies of direct observations of various foods eaten, and found that the published literature showed a similarity in the diets on the two coasts. On this evidence, at least for the ethnographic present, it is not possible to postulate a largely marine diet on the west coast compared with a mixed marine and land diet on the east. There are large differences between the environments of the east and west, and the archaeological record may reflect this, but it is possible that by using his artifact, fire, the Tasmanian was able to reduce the adverse effect of the rain forest and to create, in a limited way, a more favourable environment.[2]

The most common recognisable archaeological sites are the coastal shell middens. These are very numerous and are found in suitable locations all around the coast. On the east coast, they range in type from thin bands of shell stratified in sand dunes as at Anson's Bay and the northeast generally, to the very large solid shell middens on both banks of the Little Swanport River (Taylor 1892; Crowther 1950, p. 86; Jones 1965 *b* plate 2). There are many middens along the indented shores of Storm Bay and the Derwent Estuary, and Reber (1965) has obtained carbon dates ranging from one to eight millenia from cuts in some of these, though no information was obtained about their stratigraphy or content. The west coast is very exposed and, where overstocking has taken place, there has been severe erosion of the old stable dunes, and the formation of large unstable 'blow out' dunes. Where middens were stratified in the sand, they have been eroded, and there are some areas where the ground is covered with tens of thousands of artifacts and sand etched bones. This is the case on the north part of the west coast between Mt. Cameron West and Sandy Cape, where the excavating activities of the wind have made this a paradise for surface collectors (Pulleine 1928, pp. 310-312; Legge 1928; Crowther 1950, pp. 89-91; and Luckman 1949). On the north coast between Table Cape and Rocky Cape, there are high quartzite cliffs in which there are at least five large caves. The floors and roofs of these caves are respectively about 70 and 100 feet above sea level, and from their position and shape, they are probably old sea caves (Gill and Banks 1956, p. 32; Jennings 1959 *a*, p. 30; Gill 1961, p. 76; Jones 1965 *c*). These caves contain large shell middens.

There is a paucity of recorded stratified inland sites in Tasmania, but, nevertheless, some small occupied rock shelters have been found in the sandstone region of the south-west (Heyward 1934; Jones 1965 *a*, pp. 193 and 198), and more may be found on further search. There are many large stone quarries in the midlands (Noetling 1908, pp. 49-50), and Goede (1965, p. 146) has found a well-made stone tool in gravels near Buckland dated on both geomorphological and carbon dating evidence to the mid-recent period.

Rock carvings have been found on the west coast at Cape Grim (Robinson, 25 June, 1830), Mount Cameron West (Meston 1933; Luckman, L.1951, pp. 25-27; Luckman, J.S.1951, pp. 31-32), Sundown Creek (Ellis and Both, personal comm.), Green's Creek (Robinson, 4 Sept., 1833; Ellis, ms.), Trial Harbour (Jones, J.F.1938) and Port Davey (Reid 1954, pp. 277-278; Ellis, ms.). These are carved on a variety of rock types, and the motifs consist of circles, barred circles and dotted lines. Together, the west coast carvings form a stylistically consistent group. Elsewhere in Tasmania, carvings have been reported at Devonport by Meston (1932), though their authenticity has been questioned by Scott (1932), and a drawing or stencil of a hand was found by de Teliga and Bryden (1958) in the Derwent Valley. Ellis (1963) thinks that rock markings in Tasman Peninsula and the Derwent Valley believed by Reid (1954, pp. 273-277; 1962) to be aboriginal, are due to tree root activity. At the Bay of Fires, on the east coast, there is a long row of flat stones on a midden, which I interpret as an aboriginal stone arrangement. Excavations showed the presence of a second arrangement stratified one foot below the top one (Jones 1965 *d*, pp. 78-79).

Some of the small offshore islands were visited and occupied by the aborigines. Archaeological evidence has been found on Hunter Island (Meston 1936, p. 155), Schouten Island (Crowther 1950, p. 87), Tasman Island (Meston 1936, p. 157) and Bruny Island (Reber 1965, p. 264). There are ethnographic accounts of aborigines on Maria Island (Péron 1809, pp. 212-216), Bruny Island (Cook, January, 1777; Robinson, April to Dec., 1829), and De Witt and Mattsukyer Group (Robinson, 16 July, 1831), and the islands of the north west such as Hunter (Robinson, 13 August, 1832). The watercraft consisted of rafts and catamarans of rolled and bound bark (Meston 1936, pp. 158-161; Hiatt 1965, pp. 98-101), and the channels to be crossed, although in some cases only a few miles wide, would have been dangerous. There is no published evidence for prehistoric occupation of the large Bass Strait islands, although this may yet be found (Tindale 1941, p. 145). The lack of shell middens and other achaeological remains suggests that it is unlikely that these islands were systematically visited in recent prehistoric times.

In planning my field work,[3] I wanted to find sites with a long period of occupation in order to set up a sequence but, apart from setting up a chronological framework, I was also interested in investigating the content of some of the cultures thus isolated. I concentrated my activities on the north-west corner of the island, where I carried out excavations at the north-west coast cave sites of Sisters' Creek, Rocky Cape North and Rocky Cape South and, as a contrast to these, at the large open midden north of the West Point Lighthouse.

Rocky Cape South (Fig. I, C)

This is an eastward facing cave, inclined at 45 degrees from the vertical, in a bedded precambrian quartzite (Cave Quartzite of Spry 1957, p. 83). There is a midden at the entrance and this extends some 100 feet into the narrow crevice. At the present floor level, the cave is six feet wide and five feet high, though Pulleine (1928, p. 310) records how he had to crawl into the cave.

2. A similar use of fire has been described by Cumberland (1962) for prehistoric New Zealand.

3. Carried out in the summers of 1963-64 and 1964-65, under the auspices of the Australian Institute of Aboriginal Studies, and the Department of Anthropology, University of Sydney.

The midden deposit in the cave has been extensively dug (Meston 1956, p. 197); Gill and Banks 1956, pp. 36-40; Reber 1965, p. 267) but the published descriptions of the site were meagre and confusing, and Mulvaney concluded his section on Tasmanian prehistory (1961, p. 99) saying "systematic excavation at Rocky Cape is highly desirable. Until that time, correlations of mainland and insular prehistory are premature". My aim was to isolate and excavate some undisturbed material, and I particularly wanted to test Meston's claim for a 15-foot depth, and Tindale's theory of a typological sequence (1937, p. 34). There was a large collapsed pit immediately under the entrance, and we emptied this out first and cleaned up the side. We then excavated one corner in order to obtain a straight section, and dug an embayment six feet by three into our straight wall.

The maximum depth of undisturbed midden was ten feet, with two feet of disturbed material above this. Below the midden was a coarse gritty sand containing many sharp edged stones, and the junction with the shells was very marked. This sand was packed tight between large angular boulders, some being up to a ton in weight, and we could only excavate two or three feet down in the crevices between these rocks. The sand did not contain any flakes, bones or charcoal.

The midden itself had a complex stratigraphy (Plate 1), but it could be divided into two major units. The bottom complex was six feet thick and consisted of lenses of shelly and brown earthy midden deposits, which had been laid down horizontally. Among the molluscs represented, the 'dog winkle' *(Dicathais textilosa)*, the warrener *(Subninella undulata)*, and the limpet *(Cellana solida)*, were the most common.[4] The *Dicathais* shells were complete, but most of the *subninella* were broken. There were many bones, and the animals represented were seal, wallaby, bandicoot, rat kangaroo, bird and parrot fish. Most of the seals were Southern Elephant Seals *(Mirounga leonina)*, but there were also some Fur Seals *(Arctocephalus* sp.). In order to try and assess their relative numbers, I have calculated for each animal the minimum number killed, by counting the most common bone and dividing this by the frequency of the bone in the complete skeleton. In practice, I have used mandibles for seals and marsupials, sterna for birds, and premaxillae for the parrot fish. In a preliminary count on six spits out of twenty, I have a minimum number of 146 animals killed, of which there are eight seals, four wallabies, two bandicoots, two birds and 130 parrot fish. I have tried to translate the relative frequencies of animals to those of meat poundage, assuming that each young seal contributed 50 pounds of meat,[5] each wallaby 15 pounds,[6] and each parrot fish two pounds. Excluding shellfish, of the order of 55% of the meat came from seal, 10% from marsupials, and 35% from parrot fish.[7]

From the three by six feet embayment in the bottom complex, we obtained artifacts at a density of about 10 flakes per cubic foot, and of these, 7% were retouched implements or cores. Of the raw materials used, 40 to 50% was the local coarse quartzite, 30% a hard red and yellow quartzite, and quartz and basalt each had maximae of 25% in some levels, the quartz steadily replacing the basalt. In the lowest spits, the percentage of coarse quartzite was 65%, and a hard mudstone was also used. All these materials could be obtained from the immediate locality, namely from the walls of the cave, the beach or from a particularly hard outcrop in the local quartzite.

Typologically, the assemblage was crude and relatively undifferentiated, most of the tools being simple retouched flakes. There were some simple unifacial pebbles, and two large cores with alternate flake scars had been utilised. Contrasting with this simple stone assemblage, were 35 bone tools, some of which had been carefully made. These fell into two groups, long single ended points (115-145 mm. long) and spatulae (one was 150 mm. long). Both groups were made on wallaby fibulae which had been snapped in half, the broken edge being ground and polished until smooth. These tools were comparable with surface finds described by Crowther (1925), Meston (1956, pp. 192-195) and Plomley (1962, p. 14). At Rocky Cape, excellent examples were recovered from the base of the midden.

We located the position of Reber's Carbon-14 sample a foot above the base of the midden. This gave a date of 8,120 ± 160 B.P. (Reber 1965, p. 267).

The top complex had a maximum thickness of four feet, and it lay in a wide depression cut into the deposit of the bottom midden. This may have been done deliberately as an attempt to clean out the cave, the headroom being only six feet above the unconformity. The deposit consisted mostly of hard ash, burnt and crushed shells and large nodules flecked with fine charcoal of a soft white deposit.

The shells were of the same species as in the bottom complex. The bone material consisted mostly of small slivers, many of which were burnt, and most were unidentifiable, though fish was present. There were 1,500 stone artifacts at an average density of 60 per cubic foot, though some spits contained 100 per cubic foot. Most of these were tiny flakes and only 2½% had been retouched. The rock types were the same as in the bottom complex and used in similar proportions, with one important exception that in the top complex there were between 3 and 5% of excellent raw materials including cherts and a fine silified breccia. These are exotic to the area, the only source of one of the cherts being on the west coast. The majority of the tools were simple retouched flakes and flaked pebbles as we had found in the lower levels, but there were also a few well-made tools. These were small high domed pieces with a series of retouched concavities around the periphery, and pieces with very steep step-flaked lateral retouch, or steep retouch forming a concave edge. There were no bone tools, but given the fragmentary nature of bone generally, this need not be culturally significant.

People living on a site may light fires, cook, throw away refuse, make stone tools, use stone tools, etc., often in different parts of the site, and the material residue of these activities can differ markedly from each other. At Rocky Cape South, I think that the bottom complex was largely a refuse dump, whereas the top complex was the residue of

4. For identification and nomenclature of the shells, I have followed Macpherson and Gabriel (1962).

5. King says that the weight of an elephant seal pup at birth is 80 pounds (1964, p. 79).

6. Based on field measurements carried out at West Point by A. G. Thorne.

7. This is a crude calculation and it is only intended to give a general impression of the meat diet.

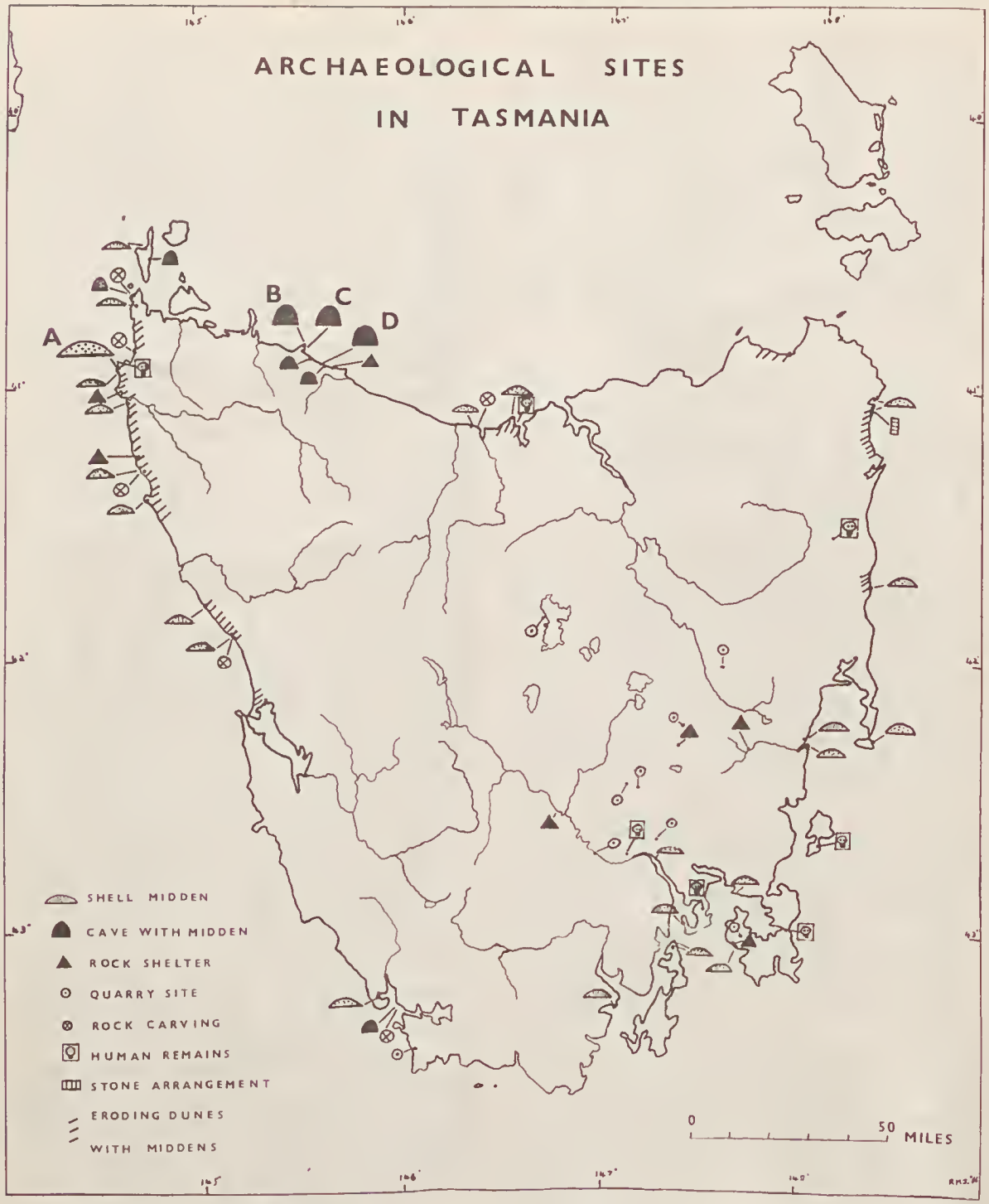

Fig. I.

A West Point
B Rocky Cape North
C Rocky Cape South
D Sisters' Creek

Map of archaeological sites which have either been published or which I can verify by personal observation. I have not included surface collection sites (Bryden and Ellis 1965).

a stone tool manufacturing and hearth area. Assessment of the differences between the two complexes is difficult, because in each case we are dealing with a different aspect of the total economic activity at the site. I think that the differences between the two complexes in ash content, condition of the bones and shell, density of stone artifacts, size distribution of flakes, and proportion of retouched pieces, can be explained in these terms. Elements which are similar in both complexes, such as the species of animals eaten, raw materials used for stone manufacture, and the majority of stone tools suggest continuity of culture. However, the introduction in the top of a small proportion of well-made tools manufactured from good exotic raw materials, implies some culture change.

In my excavations, I did not find a patinated and an unpatinated series (Tindale 1937, p. 34), and I cannot support specific cultural correlations with the Kartan and the Tartangan as suggested by Tindale (1937, pp. 34-36; 1957, p. 11). A general similarity between my finds and certain old mainland assemblages remains an intriguing possibility.

Rocky Cape North. (Fig. I, B)

This is a northward facing slit cave 30 feet high and 200 feet deep situated some 1,000 yards north of the South Cave. We excavated a pit eight feet by four feet, and the maximum depth of undisturbed deposit was nine feet. This rested on two feet of a sterile gritty sand on bedrock. In the bottom two feet of the midden, the shells were similar to those in the South Cave, and there were fish bones with some seal and macropod. The stone artifacts were made of quartzites and rough basalts, and there were a few crudely retouched flakes, with one bone tool. This was similar to the lower levels of the South Cave.

The seven feet of midden above this were quite different. The shells consisted of *Dicathais*, *Subninella*, *Cellana*, and also large quantities of *Notohaliotis ruber* (abalone or mutton fish). Of my sample of animal bones, half were of seal, and there were also wallaby, bandicoot, wombat, possum and bird. Out of the hundreds of bones excavated, there was only one fish bone. I estimate that some 80% of the non-shellfish meat came from seals. Some of the stone material was of local origin, but 30% were imported cherts and breccias. The density of flakes was only five per cubic foot, but the proportion of retouched pieces was high, rising from 9% in the lower part to 16% in the top. Most of the good tools were made of the exotic raw materials, and given the lack of waste flakes, they were probably not manufactured on the site. This stress on imported specialised tools increased as time went on. Among these tools were little disc-like cores with alternate flake scars, often the sharp trailing edge thus formed had been utilised (Fig. II: 7, 8). There were several small domed pieces with steep retouch around a central axis (Fig. II: 11), this retouch often formed a series of concavities around the periphery. There were some small flat circular scrapers (Fig. II: 9, 10), and also a range of well made retouched flakes. There were no bone tools.

There are differences between the two sites of Rocky Cape North and South which because of their proximity and similarity, cannot be explained by geographical or ecological factors. I think that they are due to cultural change through time. My chronological hypothesis is that the top half of Rocky Cape North is younger than any deposit in the South Cave, the latter site becoming abandoned when it had filled up. This hypothesis is being tested by carbon dating.

Mulvaney (in Mulvaney and Joyce 1965, table 6, p. 208) claims that unhafted tools were used exclusively at Rocky Cape throughout its period of occupation. The absence of hafted stone tools in the Tasmanian ethnographic collections and literature is strong presumptive evidence for their absence in the Tasmanian prehistoric record, but one cannot ignore the possibility of the loss of a useful art. The diagnostic criteria for recognising nonhafted tools (*op. cit.*, pp. 172, 189), are subjective as Mulvaney admits, and he does not discuss how these always distinguish hafted from unhafted tools. An example of the sort of difficulty which arises is that the *Juan* knife (Tindale 1957, p. 28; Mulvaney and Joyce 1965, p. 190), the ground edge axe, and the retouched flake figured by Tindale (1957, p. 13), could all be "utilised for hand held purposes." (Mulvaney and Joyce, *op. cit.*, p. 172), yet we know that they were hafted. On the other hand spears have been found in Victoria, with a single or double row of hafted flakes, these being "invariably unretouched fragments of primary flakes, which would escape both typological and archaeological indentification" (Mulvaney 1961, p. 97). The presence of gum on an artifact implies that it was hafted, but the absence of gum tells us nothing because gum can decay very quickly in an archaeological deposit. Mulvaney (1965, p. 189) says that a flake can be termed an "adze (i.e. hafted) only when the stepped flaking or use fracture is present. It is this functional - technological factor which distinguishes the hafted adze from hand held scrapers, Australian or European", yet steep step-flaking is a common trait of Tasmanian stone tools, and several authors "have commented on the presence of adze-like flakes in Tasmania" (Mulvaney 1961, p. 97).

Until objective criteria can be set up for the recognition of unhafted stone tools, I am unable to confirm or refute Mulvaney's interesting suggestion that the prehistoric inhabitants of Rocky Cape lacked knowledge of hafting devices.

Sisters' Creek. (Fig. I, D)

This cave is situated seven miles east of Rocky Cape. It is over 100 feet above sea level, and at the entrance, it is 35 feet wide with the roof six feet above the surface of the talus. Inside, it opens out into a chamber 30 feet wide and 15 feet high, with a small stream flowing from a crevice at the back. We dug a trench 30 feet long and five feet wide extending from just outside the lip of the cave to the inner edge of the midden inside the chamber. Excavations showed that there was a maximum depth of five feet of midden resting on four feet of sand, itself resting on bed rock (Jones 1965 *a*, pp. 193-196).

The deposit deep inside the cave consisted of bands of shell and ash. The yield of stone was low with less than ten flakes per cubic foot, and there were few retouched pieces. This contrasted with the deposit at the cave entrance however, especially immediately under the lip of the overhang. Here we found thick concentrations of a soft sticky white deposit flecked with finely divided charcoal similar to the top complex at Rocky Cape South. There

was a high density of flakes with up to 100 flakes per cubic foot in some spits, and a large proportion of these flakes was very small. The majority of the good stone tools from the site came from this area. Inspection of the stratigraphy showed that the deposits in both parts of the cave were laid down at the same time, and so the differences between them was a function of their position in the cave. The prehistoric inhabitants had sat under the entrance which was sunny yet sheltered, and had done most of their cooking and stone tool manufacture there, the darker wetter part of the cave being used primarily as a refuse area for shells and bones. The different uses to which the different parts of the cave had been put resulted in large variations in the content of the midden, and I hope to be able to quantify some of these. Such an analysis should aid in interpreting some of the differences between the top and bottom complexes in Rocky Cape South.

In the site as a whole, the shells were mostly *Subninella undulata*, *Dicathais textilosa*, *Cellana solida* and *Notohaliotis ruber*, and there were some lenses which consisted entirely of *Notohaliotis*. The bones of parrot-fish were common, and there were many crab claws. Of the mammals, there was a higher proportion of the small animals such as bandicoot, possum, rat kangaroo and rat, than was the case at Rocky Cape, though wallaby, wombat, seal and bird were also present. The seal remains were much less numerous than at Rocky Cape, and consisted mostly of single teeth and some fragments of other bones. All the teeth were of *Otariids*, probably Fur Seals (*Arctocephalus* sp.).

The raw materials for the stone tools were mostly hard quartzites which could have been obtained locally. There was also a small proportion of cherts and silicified breccias. There were some small cores with alternate flake scars, and other cores with flakes having been taken off a single platform. Among the tools were simple unifacial and bifacial pebbles, small domed pieces with steeply retouched concavities around the margin, flakes with steep step-flaked retouch, often with a concave working edge, and a series of flakes with flat retouch (Jones 1965 *a*, pp. 194-195, figs 1 and 2). The best made tools were of cherts and breccias. The majority of the implements however, were flakes or pieces of angular rock with a small amount of retouching or utilisation marks. There were two hone tools, one which had been flaked, and the other had a smooth convex end.

A carbon sample from the base of the midden gave a date of 6,050 ± 88 B.P. (N.S.W. 17).

Comparing the Sisters' Creek material with my proposed sequence for Rocky Cape, I think that it resembles most the top levels of Rocky Cape South. In both, parrot-fish were common, together with land mammal and seal. A large proportion of the stone tools were crude and made on locally obtained raw materials, but there were also typologically comparable specialised tools made on new imported raw materials, and bone tools were present.

West Point. (Fig. I, A)

The midden at West Point forms part of a grass covered hill 300 feet long, 150 feet broad and 20 feet high, and it is situated along the northern margin of a small rocky inlet. There is an extensive intertidal rock platform, and the numerous reefs and offshore islands give some protection against the heavy swells, although the site is exposed to the prevailing westerlies. Inland are several marshy lagoons behind which is a rocky terrain covered with dense coastal scrub.

We dug a transverse trench 40 feet long across the midden, and another at right angles to it (Plate 2). Our maximum depth of shell was eight feet. The deposit consisted of two midden complexes separated by an intermittent sandy band, and these had been laid down on top of and to the seaward side of an old dune. The top midden consisted of dense dark grey midden material with numerous charcoal and ash lenses, and the bottom midden was sandier, though here too, there were lenses of shell and ash (Plate 3). There is some evidence of differences in the diet and stone tool manufacture in these two deposits, but they were not as marked as in the Rocky Cape sites, and for the sake of clarity, I shall confine my comments to the top complex.

About 30,000 stone artifacts were recovered from the whole excavation at a density of up to 50 flakes per cubic foot in places. In the top complex, 95% of these were made from an excellent sponge chert. The source of this chert has never been found, but it could only have come from a few confined localities of Tertiary limestones, possibly in the mountains near Balfour, or near Mt. Cameron West (Spry and Banks [ed.] 1962, Geological map; Sutherland). About 5 to 8 per cent of the flakes had been retouched, and the large number of small flakes suggest that stone implement manufacture took place on the site. Among the implements were disc cores (fig. II: 1, 2), circular and semicircular scrapers (fig. II: 3, 4), steeply flaked concave scrapers and flat slightly curved retouched flakes. Many tools were multipurposed, having two or more working edges on them, and in this situation it is more meaningful to base one's typology on an analysis of the various traits such as concave edges or steep step-flaked edges rather than to try and study the shape of the whole tool (see Mellars 1965, pp. 231-232). These implements from West Point are similar to those from the top levels of Rocky Cape North, and bearing in mind the industrial differences to be expected in such dissimilar sites, I suggest that the two assemblages belong to the same industry (fig. II). At West Point we found a few pieces of utilised bone, but there were no well made tools as in Rocky Cape South.

Throughout the midden, by far the most common shells by weight were of *Subninella undulata* and *Notohaliotis ruber*. These were supplemented by a wide variety of other molluscs. The prehistoric molluscan fauna was the same as the present one, but the different proportions of species in the midden and on the shore show that there was a very strong cultural preference for *Subninella* and *Notohaliotis*. Both these species live in the lower part of the intertidal zone (Bennett and Pope 1960, pp. 194-198) and below the low tide. They would have to have been dived for most of the time, and this accords well with the descriptions of Labillardière (12 February, 1792) and Robinson (9 June, 1829) in south-east Tasmania of women and girls repeatedly diving into deep water for large 'sea ears,' which they separated from the rocks with wooden points or spatulae. Almost every *Subninella* had been broken, and in some hearths there was a large number of burnt operculae.

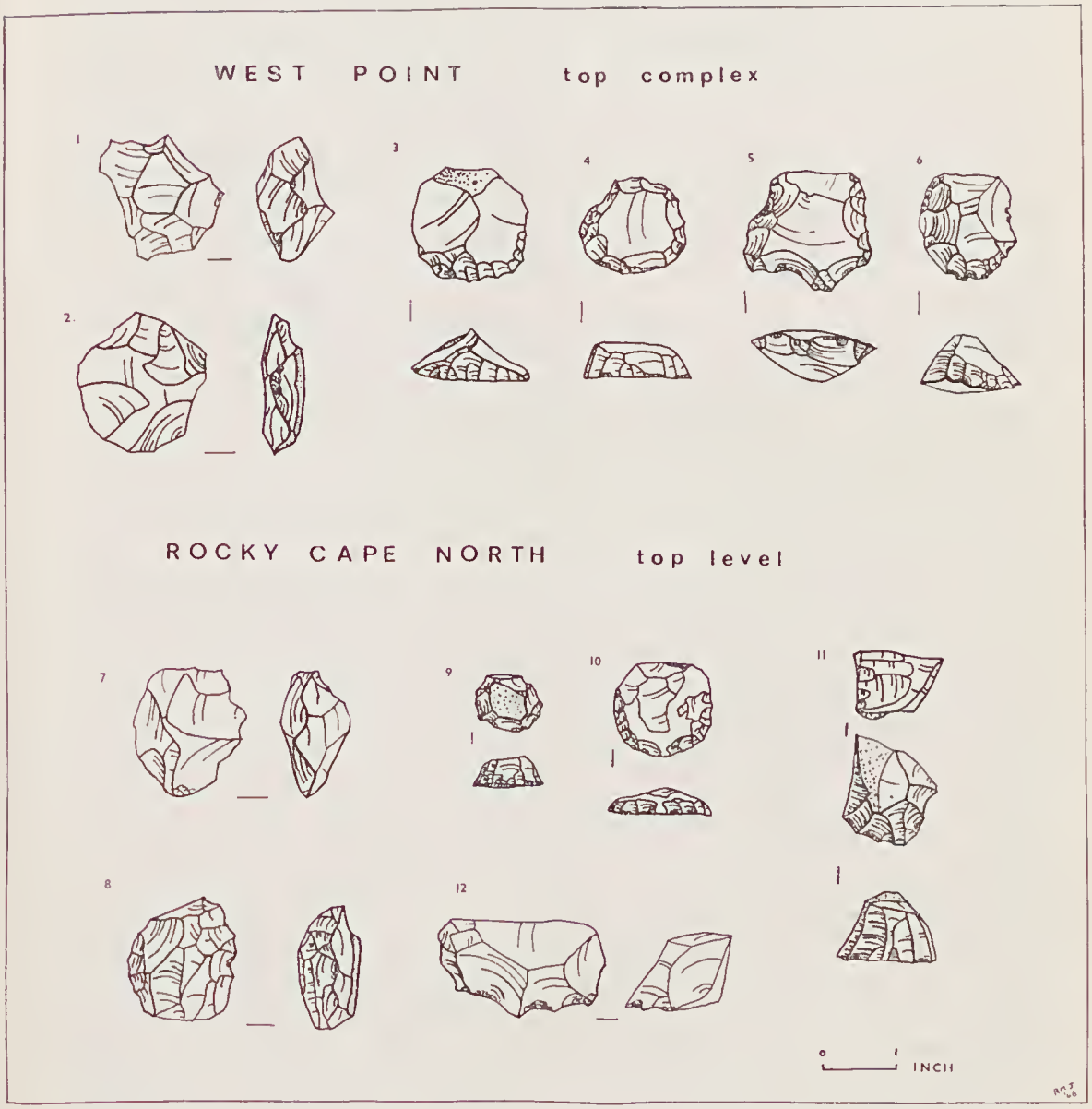

Fig. II.

Drawings of some stone artifacts recovered from a stratified context.

(Side view of specimen 5 inadvertantly drawn upside down).

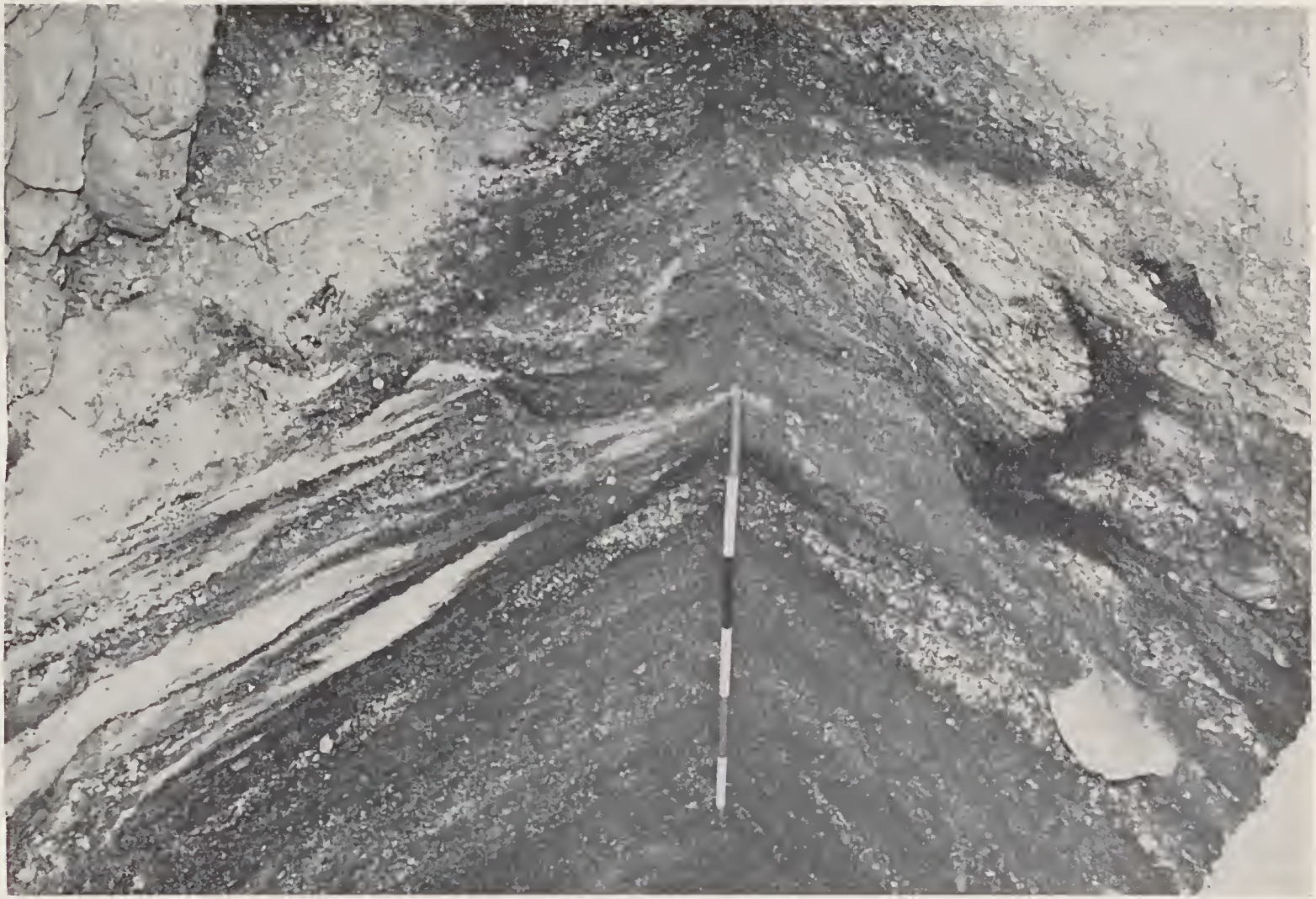

Plate 1. Rocky Cape, South. Looking at the north corner of the excavations. The bottom five feet belong to the "lower complex" and the top four feet belong to the "top complex."

Plate 2.
West Point. General view of the trenches, looking north-west.

Plate 3. West Point. Close-up of a corner between my two trenches. The bottom five are sandier than the top three feet at the corner.

I have sampled 10% of my spits for a preliminary study of the bones. In the top complex. from a minimum number of 118 individuals, 45% are bird, 23% seal, 17% macropod, 7% lizard, and below 4% each of rat kangaroo, possum, bandicoot, rat, native cat, Tasmanian Devil and whale. If we calculate roughly for meat poundage, using the same figures as for Rocky Cape, we find that seal contributed 75% of the meat, macropod 20% and bird 3%. The seals here were much bigger than at Rocky Cape, and a figure of 100 pounds of meat per animal is a conservative estimate. Using the latter figure, seal would have contributed over 80% of the non-shellfish meat.

Almost all of the seals at West Point were Southern Elephant Seals (*Mirounga leonina*),[8] but there were a few jaws and teeth of Fur Seals (*Arctocephalus* sp.). The elephant seals have a wide distribution across the Antarctic ocean, and the closest they are found to Tasmania at present is at Macquarie Island (Carrick and Ingham 1962 *a*, p. 90). Their past distribution has been noted on King Island in the Bass Strait (Péron and Lesueur 1807-1816, plate XXII), and a single breeding female has been reported on the west coast (Davies undated, p. 6), but at West Point, there is direct evidence of former large numbers of elephant seal on the Tasmanian coast.

In order to get an idea of the age of the individual elephant seals, I have compared some of the canine teeth from the excavations with photographs of equivalent teeth from known aged individuals (Carrick and Ingham 1962 *b*, plates 2 and 3). All the specimens from West Point and Rocky Cape were of young animals. There were some teeth corresponding to animals less than three months old, but there were also teeth from older animals of up to three or even five years old. The teeth of both males and females were present. At Macquarie Island, where the annual cycle of the elephant seal has been studied (Carriek, Csordas, Ingham and Keith 1962), each age and sex has its own regular sequence of seasonal activities, (pp. 130-131), and there is a well marked ebb and flow of the population throughout the year. In general, the shore population has three peaks, namely a breeding season for adult females and breeding bulls in spring betwen August and early November, the pups being born in September and going to sea in Decemher; a moulting season first for immature animals and later for mature animals from November to April; and a winter "haul out" for immature animals from March to August. This seasonal cycle is closely adhered to throughout the present geographical range of the speeies (*op. cit.*, p. 151), though Paulian (1954, p. 377), quoting early records, suggests that the hreeding season at King Island was between July and August. At West Point all the animals killed were immature so, if we assume that the annual cycle was basically similar to that outlined above, then the available periods for hunting would have been in early summer for the newly born pups, mid-summer for moulting immature animals from two to four or five years old, and early and mid-winter for hauled out immature animals from six months to about three or four years old. From the teeth of very young pups, the site was at least occupied in early summer, though it is probable that the young seal population was also exploited at the other availahle periods.

In my excavations, there was a minimum number of 300 seals and, extrapolating to the whole site, there must have been several thousand seals killed at West Point. Inspection of many wind-eroded middens along the coast, shows a similar high density of seal bones. Thus on the west coast, we have evidence of large scale prehistoric sealing activities based on the elephant seal. At the north coast sites, elephant and fur seals were an important item of diet at Rocky Cape, and fur seal supplemented the diet at Sisters' Creek. This contrasts sharply with the ethnographic literature, where there are only two published eye witness reports of Tasmanian aboriginal sealing, namely those of Kelly in January 1816 at Georges Rocks (Bowden 1964, pp. 40-41, 106-108), and Robinson on 10 February 1830 at Cox Bight, though Robinson also records story telling of sealing exploits in south west Tasmania (15 July and 15 December, 1831).

It is possible that the European sealing activities in the Bass Strait begun in 1798 had totally disrupted the aboriginal sealing economy by the time that the aborigines were observed by Robinson and his contemporaries. Most of the European sealing records refer to the taking of fur seals, over 100,000 seal skins being brought back to Sydney between 1800 and 1806 (Bowden 1964, p. 5), and Plomley (1966, p. 1006) says that the elephant seal was not of local importance because "the hunting of seals for their oil was largely neglected in the straits". However, Boys (1959, p. 28) says that in 1799, a vessel called the Martha reached King Island and "obtained a good return of skins and sea elephant oil". Crowther (1937, p. 79) says that by the time of Kelly's voyage to the Bass Strait in 1813, "the sea elephants of King Island had been practically exterminated". Certainly on Maequarie Island, sealers such as Kelly extensively exploited the sea elephants for their oil (Crowther 1933); Bowden 1964, p. 14). Possibly the Bass Strait sea elephant population became extinct very quickly under the combined impact of Aboriginal and European exploitation. Another possible explanation for the discrepancy between the archaeological and ethnographic accounts, is that the aborigines themselves had caused the extinction of the elephant seal on the Tasmanian mainland in prehistoric times. We need carbon dates for the latest phase of aboriginal sealing to help solve this problem.

The bird remains at the site were mostly coastal birds, including gulls, petrels, albatrosses and mutton birds. Also present were hawks and ducks. There was a notable absence of fish from the midden, for out of over 20,000 bones recovered, only four or five were of fish.

Together with the exploitation of marine foods, there was a steady significant contribution from the land,[9] and all the species of land animals found in the midden can be found at the present day in the immediate vicinity. This fauna belongs to the coastal sedgeland environment, and the evidence from the excavations suggests that the sedgeland, be it a pyrogenic artifact of the Tasmanians or not, has existed at West Point at least since the time of formation of the midden.

On all the criteria that I have used at Rocky Cape, I can correlate the cultural remains from West Point with those from the top levels at Rocky Cape

8. I wish to thank Mr. Basil Marlow of the Australian Museum for identifying the seal bones.

9. According to the ethnographic record, vegetable foods from both the land and the sea were a significant part of the diet (Hiatt 1965, table C, ff. p. 79), but unfortunately no traces of these were found in the midden.

North. I suggest that in general terms, these two were contemporary. Reber (1965, p. 266) dug a small slit trench on the north west side of the midden at West Point. From the base of this, seven feet from the surface, he took a carbon sample which gave a date of 2,350 ± 266 B.P. I have not correlated Reber's trench with my own excavations. South of the lighthouse is another similar midden, from the base of a four foot deep trench cut into the side of which Reber obtained a date of 2,600 ± 120 B.P. From what I could judge by inspection of the section of this cut, its contents were similar to the first midden.

Human Remains.

In the present state of speculation concerning the racial affinities and origin of the Tasmanian aborigines (Birdsell 1949, p. 120; Macintosh and Barker 1965, pp. 47-55), there is an urgent need for prehistoric human remains from Tasmania. We were fortunate to discover some at West Point. There were several single teeth in the midden, and a lower right second molar described by Macintosh and Barker (1965, pp. 56-66) belonging to an adult, probably male, was heavily worn, and had severe erosion of the roots due to periodontal disease. In the sand between the top and bottom complexes, we found two small pits filled with burnt and broken human bones, and at the base of the lower complex, there was another similar pit. There were fragments of skulls and post cranial material. Some of these, although burnt, were in good condition. Altogether, there were several individuals represented, and a detailed anatomical description is being prepared by Mr. A. G. Thorne[10]. Apart from their anatomical value, these finds give some information about prehistoric burial customs at the site. The evidence points to burning under conditions which did not allow complete incineration of the bone. The bones were then in some cases broken systematically, and collected together with charcoal, and deposited in little pits eighteen inches wide and twelve inches deep dug into sand or sandy midden. This may have occurred on the site, because there was a wide scatter of burnt human fragments, charcoal and black sand near two pits, and in most cases, the edges of the burnt broken bones were unabraded. In one pit were the foot bones of several wallabies, and the claws of a large hawk. In another were 30 small and two large shells, each pierced with a small circular hole. Following ethnographic specimens (Plomley 1962, p. 10-12; Ling Roth 1899, p. 132), I suggest that the shells and also the animal's feet were parts of necklets of some sort, placed with the ashes of the diseased as grave goods.

There seems to have been some variety in the burial customs of the Tasmanian Aborigines. In some cases, bodies were buried or abandoned without any visible treatment (Crowther 1939; Lord 1919; Crowther 1942, p. 91), in other cases relatives carried dessicated flesh or ashes in little bags (Ling Roth 1899, p. 64; Pulleine 1924; Plomley 1962, pp. 10-11). There is also evidence for the widespread occurrence of cremation. According to Robinson's magnificent descriptions (e.g., 31 May, 1829; 30-31 July, 1832), the body was arranged or bound in a flexed position, placed on a small frame with firewood all round, and then burnt. The unburnt fragments were broken and poked with poles and then [they] "carefully scraped the ashes together and mixed sand with it, and then laid some grass over it." (Robinson, 31 July, 1832). Labillardière (12 May, 1792) found the ashes of a fire with burnt and broiled fragments of human bone and flesh in it. In 1802, on Maria Island, Péron (1807-1816)[11] found a wigwam of bark under which was a circle of stones holding down a flattened cone of plaited grass. This grass covered a circular pit 15 to 18 inches in diameter and 8 to 10 inches deep, containing burnt and broken fragments of human bone, some still containing calcined blood. The following day, he found a similar grave, with drawings on the inside of the bark wigwam but, in this case, the structure had decayed a great deal, and Péron noted that in a short time these graves would look like old fireplaces. Crowther (1934) found burned fragments of human bone in little black depressions in sand at Sandford, and he said that "it is difficult to account for the broken down condition of these bones, except by deliberate fractures following partial incineration". Digging further, he found part of the left side of the skeleton, flexed and unburned, and he inferred that the body, having been treated as in Robinson's account (31 May, 1829), had fallen over before incineration.

The finds from West Point are fully consistent with this evidence for cremation, and in turn extend the traditions back to the time of the foundation of the midden.

Conclusion

By correlating the preliminary analyses of the contents of the four sites just described, I am in a position to set up a speculative sequence for the north-west corner of Tasmania. It is a hypothesis based on two major assumptions: firstly, that my excavations are a good sample of my sites and my sites a good sample of the area and, secondly, that my relative dating scheme is in general confirmed by radio carbon dating.[12]

At about eight or nine thousand years ago, the sea in its post glacial rise reached approximately the present coastline on the north coast near Rocky Cape (Godwin, Suggate and Willis 1958; Hails 1965, p. 67; Jennings 1959 *b*, map p. 50). People living in a fairly confined coastal strip arrived at the cave and occupied it for the first time. They had a coastal economy, eating shellfish, seal and parrot-fish, but some land animals were also eaten. The stone industry was unspecialised, involving the manufacture of only crude cutting and smashing implements. For raw materials, they used readily available, rough, raw material. They had a sophisticated bone industry. This phase is represented by the lower complex in Rocky Cape South, and the lowest two feet of Rocky Cape North.

Some time after this, we begin to see some changes especially in the exploitation of better stone raw materials, the knowledge of which would have involved a great deal of casual exploration. In addition to simple retouched flakes and pebbles, some well made tools were used. The dietary economy had not changed very much with shellfish, parrot-fish, seal and land animals being eaten. Sisters' Creek cave was first occupied during this phase about 6,000 years ago, and Rocky Cape South was filling up.

10. Department of Anatomy, University of Sydney. I wish to thank Mr. Thorne for the information concerning the human anatomical material.

11. Chapter XIII, pp. 265-273; see also Roth 1899, pp. 116-118.

12. My carbon samples are being dated by Miss A. Bermingham, Institute of Applied Science, Melbourne.

The next phase is represented by the top levels of Rocky Cape North and the West Point midden. By this time fish had dropped out of the diet, and well finished bone tools were no longer made. The meat dietary economy was still orientated towards the sea, although a wide range of land animals was actively exploited. Sealing was of great importance, especially on the west coast where very large sites such as West Point implied a specialised exploitation of young seals, probably seasonally. Quarries of good raw material were well known and the tool makers were very selective in their choice of raw materials, using only the best material in sites close to the sources, and importing either blanks or finished tools in sites far from the source. The range of small, well-made tools implies specialised uses for them, and possible functions may include cutting and wood scraping. During this phase, people were cremated, and their remains broken and buried in little pits. In some cases, these were accompanied by pierced shells and animals' feet. Dates from the west coast middens suggest that this phase might be at least 2,000 years old. The last phase was the "ethnographic present" which, with its diet, seasonal exploitation of foods, exploitation of good ochre and stone material, and burial practices, seemed to be similar to the latest prehistoric phase. One difference was the absence of sealing, which had probably been disrupted by European sealers.

If this hypothetical sequence is supported by carbon-14 dating and further analysis, the next question to ask is how general is it. Is it valid for the whole of Tasmania, or only for the north-west corner?

In the sequence, both parrot-fish and bone tools are present in the lower part, but are absent in the top part. Ethnographically, there is not a single reliable observation of the Tasmanian Aborigines eating scale fish (Hiatt 1965, pp. 53-57), and no bone tools were seen either being manufactured or used.[13] It is interesting to speculate whether or not this absence may be explained in terms of discontinuity through time,[14] and here the sequence may have validity throughout Tasmania. On the other hand, given the fact that well differentiated stone industries are known on the mainland which are older than 10,000 B.P., and which bear some morphological resemblance to Tasmanian assemblages (Mulvaney and Joyce 1965, p. 207), it is highly unlikely that all the first migrants to Tasmania were ignorant of sophisticated stone tool manufacture, and then independently invented their own traditions. It is more likely that the traditions of stone tool making continued unbroken in some part of the island, and in this respect, possibly because of the effect of the rain forest, the north-west might have been a fringe zone to the main area of early occupation.

I see the sequence in the north west as documenting a gradually improving exploitation of an environment which may have been unfamiliar and inhospitable to the first comers pushed back into new territory by the post glacial rising sea.

13. There were, however, wooden points and spatulae.

14. The dichotomy between the presence of fish bones at Rocky Cape and the absence of references to fish in the ethnographic record, has also been explained in terms of a taboo against fish eating in most parts of the island except in the north-west (Gill and Banks 1956, p. 38; Meston 1956, p. 198; Plomley 1966, p. 36 note 22). Another explanation offered was that the parrot-fish had been carried up to the midden by chance, e.g., by people collecting mutton-fish, crayfish or kelp (Kemp 1963, p. 243).

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TASMANIAN MUSIC, AN IMPASSE ?

by

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It will be appreciated that any approach to the subject of this paper, Tasmanian Music, is fraught with frustration. In the present enquiry an attempt will be made to avoid some of the blinder alleys of non-information without underestimating their existence.

Our present knowledge of the music of the Tasmanian aborigines, and of matters relevant to it, is based on

(1) brief descriptions of aboriginal singing to be found in early accounts of Tasmania, known then as Van Diemen's Land;

(2) words of songs written down by G. W. Walker in 1832, R. W. Davies (1846), J. Milligan (1855) and others;[1]

(3) music notation of one aboriginal song arranged for voice and piano accompaniment by Mrs. Logan (1835);[2]

(4) phonograph recordings (in the rooms of the Royal Society of Tasmania in 1899 and at the home of Mr. Horace Watson, of Sandy Bay, Hobart in 1903) of songs of Mrs. Fanny Cochrane Smith who was born on Flinders Island.

The chances of adding to these meagre musical remains are now slight. But even today, more than a hundred years after the last full-blood Tasmanians performed their songs and dances, might it not still be possible to find a second or third generation descendant still able to recall tribal song-fragments which have been learned and passed on by older relatives? The faint hope underlying this question pervades the following study which, in the main, offers more questions than answers, more speculation than conclusions.

As previously pointed out[3] the recordings undertaken by the Royal Society of Tasmania in 1899 are among the oldest of their kind. Only ten years earlier Dr. J. Fewkes took into the field for the first time a phonograph to record the songs of the Passamaquoddy (American) Indians. (Sachs, 1943).

Periodically Mrs. Fanny Smith's songs have aroused public interest, especially in Tasmania. And for different purposes several sets of recorded copies have been made from the original wax cylinders.

Cylinder copies were made more than fifty years ago by Horace Watson of Sandy Bay for Ritz's study on Tasmanian speech. Ritz pays tribute to Watson who, as "an ardent and sympathetic student of Aboriginal life, had shown much kindness to Mrs. Fanny Cochrane Smith, one of the decendants of the Aboriginal Tasmanians" (1909, p. 49). Ritz adds that "on one occasion she was delighted to please him [Watson] by singing two native songs with a phonograph. The circumstances thus render the sincerity of her performance unquestionable. The records are in perfect order and Mr. Watson, to help me in my study of Tasmanian speech, most generously gave me a copy of each".

Referring to the two song styles, about which more will be said, Ritz writes that "the first song is distinguished by the precision of its rhythm, and the second is perhaps an imitation, not of a Highland bagpipe, as Bonwick opined, but of a melody of a native magpie which most unmelodiously the zoologists call a 'piping crow' ". The suggestion that the Spring Song may be based on vocal imitations of a bird call is not to be treated lightly, especially if the trills and other "coloratura" effects which distinguish this melody are considered.

Another set of cylinder copies made by Horace Watson in 1909 for Mr. Robert Hall, Curator of the Tasmanian Museum, is mentioned by Longman (1960, p. 81). These duplicates remained in the possession of Mr. Sargison of Hobart until recent years, when he presented them to the Tasmanian Museum.

In 1949, at the time of the ANZAAS Congress in Hobart, some of the old cylinder recordings were re-discovered and played; and, on 11th January, the Australian Broadcasting Commission recorded (direct acetate disc)[4] an interview with Norman B. Tindale, Curator of Anthropology, South Australian Museum. In the discussion Mr. Tindale makes reference to Tasmanian descendants still living on Kangaroo Island, Cape Barren Island and Cummeragunja, an Aboriginal settlement on the southern border of New South Wales. The cylinder recordings played during the interview in Hobart were later dubbed in Sydney (1953) and a processed disc prepared by Columbia Graphaphone (Aust.) Pty. Ltd., now known as E.M.I. (Aust.), for the Australian Broadcasting Commission. The title of the processed disc is: "Songs and War Chants of Extinct Tasmanian Aborigines (Dubbed from wax cylindrical records from the Hobart Museum)"[5].

In 1959 the first tape copies were made acoustically from the full collection of eight cylinders housed in the Tasmanian Museum (See Recordings and Contents). The transfer was carried out by Murray J. Longman, now Chief Engineering Geologist in the Department of Mines, Hobart, who used an amplifier operating in conjunction with the tape recorder. The care taken by Longman in effecting the cylinder repairs and in adjusting the speed of mandrel rotation, obviously too fast in some of the earlier copies, has produced commendable results.

Music notations of some of Mrs. Fanny Smith's songs, as heard on the processed disc (ABC, 1953) were first attempted in 1956.[6] Further notations and melodic analyses resulted in the following cthnomusicologieal conclusions:-

> In its syllable manner and additional descents, or "codas," the Tasmanian "corroboree" style (Dance Song versions) resembles Australian aboriginal singing particularly in South Australia, and the Centre. But the rising penultimate tone and triadic emphasis in the Tasmanian examples are not typical of Australian singing styles in general. The "legato" Tasmanian song (Spring Song), with its central tonic, binary division and triadic base has more affinity with some New Guinea and possibly other Island styles.
>
> It may be concluded from these fragments, and from the written reports by early observers in the last century, that Tasmanian song-styles were widely varied. It seems that they range from monotone reiterations to songs of a relatively sophisticated nature such as the "legato" or "Spring" Song. (Moyle, 1960, p. 75).

Dr. Catherine Ellis claims (1964, p. 345) that the 1960 transcriptions of the "corroboree" or Dance Song are "very like the music of the Coorong, in South-east of South Australia, where we find emphasis given to notes of the tonic triad". In the transcriptions for the present paper the Song from Guichen Bay by a male Aboriginal singer of the Coorong district, South Australia, recorded by N. B. Tindale in 1937 (1941, p. 236), and the Tangane Song sung by a woman in East Wellington, S.A., recorded by R. M. Berndt in 1943, have been selected for comparison (see below).

In this present study, which in some respects is a sequel to the 1960 paper, more attention has been given to melodic direction, or "contour", than to static (and arbitrary) scalar arrangements of aurally estimated pitches. And it is contended that significant demarcations of musical style are to be found by giving as much, or more, eonsideration to the actual melodic movement in the pitch continuum.

An attempt will also be made here to examine connections existing between some of the earliest written accounts of Tasmanian aboriginal singing and the preserved sound-recordings. In this way it is hoped that the sound-recorded evidence may be better evaluated and the little there is to know about Tasmanian music brought more clearly into view. To this end a new series of music notations has been prepared and songtexts (words and syllables) added for the first time. These tone/text transcriptions have been attempted only after numerous re-hearings and with better playback equipment than in use in 1959. It need scarcely be said that every possible aid is needed for such work where sound tracks are worn, cylinders cracked or broken, and scratch level high.

During the last century a few Tasmanian song verses were written down in native dialect and according to the skill of one or two interested persons. Of notable value to the present study are the songtexts of George Washington Walker, a member of the Society of Friends, who visited Flinders Island in October, 1832. Indeed the close similarity between several of the previously published texts and the words of the Dance Song, as sung by Fanny Smith, has proved to be one of the most profitable approaches to the subject under discussion.

A text found in George Washington Walker's diary (15th October, 1832) and published by James Backhouse Walker (1898, p. 172) is reprodueed below. G. W. Walker remarks that it is "a popular song among all the aboriginal tribes, of which I have not obtained the meaning, it being involved by them in some mystery".

> Pŏppy̆la-renŭng-onnyna-Pŏppy̆la, etc., Pŏppy̆la, etc., etc.
> leminganya-leminganya-leming, etc.
> Taukumminganya-Taukumminganya, etc., etc.
> Nyna tepe rena-ponnyna-Nyna, etc., Nyna, etc.
> Nyna nara pewilly para. Nyna nara, etc., Nyna nara etc.
> Nara pewilly pallawoo! pallawoo!
> Nyna nara pewilly para pewilly pallawoo! pallawoo!
> Nyna nara, etc., Nyna nara, etc., etc.

As James B. Walker observed *(op. cit.)*, Milligan published the same song "with certain differences" in his Vocabulary (1855, p. 273). Milligan's title is "Aboriginal Verses in honour of a Great Chief, sung as an accompaniment to a Native Dance or Riawé."[7]

> Pappĕlă Rāynă 'ngōnynă, Pappĕlă Rāynă 'ngōnynă
> Pappĕlă Rāynă 'ngōnynă!
> Tōkă mēnghă leăh, Tōkă mēnghă leăh
> Tōkă mēnghă leăh!
> Lūghă mēnghă leăh, Lūghă mēnghă leăh,
> Lugha mengha leah!
> Nēnă tāypă Rāynă poōnynă, Nēnă tāypa Rāyna poōnynă,
> Nena taypa Rayna poonyna!
> Nēnă nawră pēwyllăh, Pallăh nawră pēwyllăh,
> Pellawăh, Pellawăh!
> Nena nawra pewyllah, pallah nawra pewyllah,
> Pellawah, Pellawah!

In answer to a questionnaire published by the British Association for the Advancement of Seience, R. W. Davies (1846, p. 411) furnished the following text under the title "song of the Ben Lomond tribe".

> ne popila raina pogana,
> ne popila raina pogana,
> ne popila raina pogana,
> Thu me gunnea,
> Thu me gunnea,
> Thu me gunnea.
> Naina thaipa raina pogana,
> Naina thaipa raina pogana.
> Naina thaipa pogana.
> Naara paara powella paara,
> Naara paara powella paara,
> Naara paara powella paara,
> Ballahoo, Ballahoo,
> Hoo, hoo!
> (Their war whoop very guttural)

Unable to obtain a translation for the above, Davies hints that the matter may be better left alone. "I cannot translate it", he says, "nor could I do so, is the subject very select". But Ritz, who made a special study of these three texts, regarding them as an important "trilingual record of the same meaning" (1908, p. 75), takes Davies to task for his literary omissions. Ritz interprets Davies' version in what he calls "plain language":

> Lo! with might runs the man: my heel is swift like the fire,
> my heel is indeed swift like the fire. Come thou and run like a man;
> a very man, a great man, a man who is a hero!
> Hurrah!

Some of the minor differences (spellings) in the above Tasmanian song-texts would be due, no doubt, to personal methods of writing down the sounds. From what we know of verse variants in Australian aboriginal songs, major differences (words and verse lines) can occur in texts which have been obtained for songs, allegedly the same, but performed by different singers and perhaps belonging to different tribal groups. Some of the differences between earlier written texts and those of the three versions of the Dance Song appear to be due to the fact that Fanny Smith has remembered some parts of the song better than others. The line *nyna tepe rene pogana* is undoubtedly her best. And she is very sure of the final verbal sequence: *para nara pewilly pallawoo pallawoo.*

Fanny Smith's own versions of the Dance Song text are given below:

VERSION A.

Poppyla (waln wala pawalawa)
Poppyla (waln wnla pnwalawa)
Nynn tepe rene pogana
Nyna tepe rene pogana
Nyna tepe re' pogana
Tepe nara pewilly
Para nara pewilly
Pallawoo
a Nyna nara pewilly
Para nara pewilly
Pallawoo pallawoo

VERSION B.

Taukumminganny-nya-na
minganny-nya
Taukumminganny-nya-na
mlnganny-nya
Nynn tepe rene pogana
Nyna tepe rene pogana
Nynn tepe re'ne pogana
Nyna tepe rene pognna
Nyna tepe re' pogana
Nyna nara pewilly
Para nnra pewilly
Pallawoo pallawoo
n pewilly parn pewilly
Parn na' pewilly
Pallawoo pallawoo

VERSION C.

Tnukummlnganny-nya-la(?)
minganny-nya
Taukummlngnnny-nya-la
minganny-nya
Taukummingan-ny-nya-la
minganny-nya
Nyna tepe rene pogana
Nynn tepe rene pogana
Nyna tepe rene pogana
Nynn tepe rene pogana
Nynn tepe rene pognna
Ny' nara pewilly
Para nara pewilly
Pallawoo pallawoo
a Nyna nara pewilly
Para nara pewilly
Pallawoo pallawoo

Taukummlnganny-nya-la
minganny-nya-la
Nyna tepe rene pogana
nyna tepe rene pogann
ln nnra pewilly
Pallawoo pallawoo
a Nynya nara pewllly
Para nnra pewilly
Pallawoo pallawoo

The above Dance Song texts, which appear in the present series of music transcriptions, have been derived mainly from George Washington Walker *(op. cit.)*. The word *pogana* is taken from Davies' text. Walker's spellings have been retained though there may be room here for linguistic revision. The word *pallawoo*, for instance, has been rendered by Worms (1960, p. 12) as *bah-war* and the meaning given as "man here".[8]

In the text for Dance Song, Version A, the syllables in brackets are hypotheses only. Words corresponding to the verbal sounds as heard in the 1899 recording have not been found in the published texts of Walker, Davies, Mrs. Logan or Milligan. It will be noted that Versions B and C commence with another textual unit, one which is extended in Fanny Smith's song by means of part-repetition. Version C contains a second or repeated verse; and in all three versions of the Dance Song it will be noted that an extra syllable "a" is occasionally introduced to start the line.

Genuine Tasmanian songtexts for the Spring Song, if they exist, have not been found. The syllables appearing here (see transcription of the Spring Song) are aural suppositions only. Restoration of the real Spring Song text, and its meaning, will be left to one skilled in Tasmanian language and mythology, assuming that this song *is* sung in Tasmanian.[9]

As previously noted (1960, p. 73) two markedly different styles of singing are demonstrated in the Fanny Smith recordings. In the Spring Song the florid style and absence of a regular precise rhythm are primary marks of distinction and the sustained (legato) style, which results mainly from the singing of several tones to one syllable (see transcription No. 4) contrasts with the syllabic, or one-tone-to-one-syllable, style of the Dance Song. (Transcription nos. 1 - 3).

A transcription of the "hymn" has been included to demonstrate Fanny Smith's manner of vocal improvisation (No. 5). After the first ten bars she appears to revert to more familiar melodic procedures which are both triadic and pendular. Apart from the words "Praise the Lord" the singer's diction in this recording has not been followed.

The controversy over Mrs. Fanny Cochrane Smith's parentage (Barnard, p. 1889 and H. Ling Roth 1898 and 1899, Appendix G) need not be reiterated here. The subject has no real bearing on the authenticity or otherwise of the contents of her song recordings. It will be noted that Mrs. Logan's arrangement of a "Song of the Aborigines of Van Diemans [*sic*] Land", commences with the words *Popela Ranca gonca* and includes the line *Nina tepea ranca ponena*. Despite minor differences these words, and the style of the written vocal part, provide adequate evidence to support the statement that Fanny Smith's Dance Song was widely known in Tasmania about 100 years ago. It was "done" for Mrs. Logan by "Mifs", presumably an aboriginal singer,[9a] and the performance occurred more than 60 years before Fanny Smith sang the Dance Song to members of the Royal Society of Tasmania and to Horace Watson. (See Note 2).

The Spring Song lacks supporting written evidence and it still remains to be found how long, and by whom, this song "about birds and flowers" had been regularly practised. It is known that springtime was an important season for the Tas-

manians. If it could be established that Fanny Smith's Spring Song was connected with aboriginal rites of spring in Tasmania, it would follow that this second song would also have been widely known on the island and possibly over a longer period than the Dance Song.

If the above speculations could be substantiated, the theory that the oldest (unwritten) music is also the simplest would again be challenged.

As a child Fanny Smith, who was born on Flinders Island in about 1833, would have heard aboriginal music frequently. One might also reasonably assume that some singing would continue in the last settlement at Oyster Cove where she was ultimately taken in 1847 (J. B. Walker 1897, p. 156). Writing of the Flinders Island community, R. H. Davies tells us that singing and dancing were the principal amusements. Aborigines from West and East of Tasmania joined in the same corroborees, singing the same songs. They were mainly songs of the Easterns and it was thought that the Westerns "did not understand the purport of the words" (1846, p. 409). Backhouse (1832-3, p. 82) saw a Horse Dance, obviously post-European in origin, in which dancers progressed in a line each holding the loins of the individual in front. Davies (*op. cit.* p. 416) describes a Jumping Kangaroo dance which commenced in slow tempo, then accelerated when the singing rose in pitch.

Lloyd (1862, p. 49) gives a graphic account of a performance in which a "sorry, loquacious old beldame" taunted a hunter for his cowardice. Then followed the hunter's reply, in which he vigorously proclaims his many deeds in war, and his pause from exhaustion while a chorus of female singers confirmed his heroic deeds in a "loud and solemn chant".

References to Tasmanian sound-producing instruments are sparse. Lloyd tells us that the women, mentioned above, accompanied their "monotones and monotonous voices by playing upon greasy kangaroo rugs which were rolled up in some peculiar manner so that when struck by the open hand the sound resembled that of a muffled drum". On the Australian mainland skin bundles of various kinds, beaten by hand in song accompaniment, have been observed in South Australia by Taplin (1879, p. 107) and R. H. and C. H. Berndt (1964, p. 309); and in North Queensland in the Gulf Country by Roth (1897, p. 120).

Lloyd also reports (*op. cit.*) that "others joined in the rude concert by beating time with two short dry sticks, and that with a precision adapted for an orchestra". Here again parallels on the mainland are to be found. In Australia two-handed stick beating by male Aboriginal singers is widespread, especially north in the Northern Territory (Arnhem Land), where the stick-beating singer is accompanied by a didjeridu player. But one may attempt little more than superficial comparison of Tasmanian and Australian percussion accompaniments. References to the musical use of the sound-producer, i.e. to rhythm, tempo, initial and terminating percussive effects etc., are omitted from Tasmanian reports.

A Tasmanian mortuary ceremony held on the first night after death, during which participants sat round the body "using rapidly a low continuous recitation to prevent the evil spirit from taking it away", is mentioned by Davies (1846, p. 418). From this and other such accounts we may conclude merely that singing or reciting of some kind was practised during many aboriginal ceremonies in Tasmania and that, in some of them, the principal roles were taken by women as well as men.

References to female singing are more informative. Many observers have commented on the songs of the Tasmanian women, some showing keener powers of aural perception than others. Both Brough Smyth (1878 (II), p. 390) and H. Ling Roth (1890, p. 148) quote from George Hull's account (c. 1825) of singing by women on the west bank of the Tamar, opposite Launceston. According to Hull they sang "all joining in concert, and with the sweetest harmony; the notes not more than thirds". In an attempt to improve on this musically inexpert description Hull remarks that the effect was "like what it would be if you began one chord on the organ before you took your fingers from the keys of another". What is probably the same musical effect has been more successfully communicated by Labillardière, one of the naturalists attached to the French expedition which undertook the search for La Pérouse. A translation of Labillardière's words reads as follows: "Several times two of them sung the same tune at once but always one third above the other forming a concord with the greatest justness" (1783, Vol. II, p. 50). Bonwick (1870, p. 30) was sceptical of the Frenchman's report. "How fortunate were our Gallic friends!" said he, "Other travellers and colonists have never, perhaps, listened to such a Tasmanian aboriginal duet". Bonwick may not have known that an independent observer, George Washington Walker (Manuscript Journals, 1832 in J. B. Walker 1898) had also heard women singing in two parts. Indeed Bonwick himself may have heard part-singing without recognising it for he recounts walking out one evening by the sea-shore of D'Entrecasteaux Channel and of hearing a "low chanting tune" of the Tasmanian old women of the station. The tune had a "peculiar mournful sound" in which Bonwick detected "a droning hum with a shriller note" (1890, p. 30).

On Flinders Island in 1832 George Washington Walker was surprised to hear "some women sing tenor [*sic*] while others sing treble" during the performance of a Hunting Song and concluded that such singing showed "a greater knowledge of music". He had previously listened to some solo singing by a male leader of the Port Dalrymple tribe.

Though a common one, the belief that part-singing, or polyphony, can be achieved only after a certain degree of Western musical learning, is not shared by those who have heard indigenous singing in Africa, parts of New Guinea, Fiji, New Caledonia and the West Caroline Islands. It is not shared by Curt Sachs who observed (1962, p. 175) that rudimentary polyphony as an improvised spice of simple monody is almost all-present . . . . . Three large sections of the world, (1) the Malayo-Polynesian area, including Melanesia, New Guinea, Indo-China, and the ancient Far East, (2) the Caucasian area with radiation to the northwest and west, (3) Central and South Africa, have created polyphonies on a level to be compared with the part-writing of medieval Europe".

Sachs considers "third parallels" just as African as they are European (*op. cit.* p. 179). Forster heard singing of this kind by the Maoris (1777, p. 477). In Darwin, Northern Territory, in 1962, a group of young boys from Bathurst Island, off the northwest coast of Australia, sang a song in parallel "thirds" (1964, Disc 5B). In reply to questions the boys said their people had always performed camp songs in this way.

On the Australian mainland regular singing in "third parallels" has not been reported although various vocal polyphonic phenomena, produced by a more or less momentary overlap of the voices of two or more groups, have often been heard in central Australian regions and in, and adjoining, northeast Arnhem Land.

On Flinders Island, in 1832, George Washington Walker obtained the following songtext for a Hunting Song from the same women who had "shown a greater knowledge of music". It is entitled "Aboriginal Song sung by the Women in Chorus by various tribes of the Natives of Van Diemen's Land" (J. B. Walker 1898, pp. 171-172). G. W. Walker's transcription and English translation are as follow:-

Nikkĕh ningĕh tibrĕh nickĕh mollўga pollўlă...
The married woman hunts the kangaroo and wallaby...
Nāmŭ rykēnnĕh trĕhgānă...
The emu runs in the forest...
Nabĕh thinninnĕh trĕhgānă...
The boomer (kangaroo) runs in the forest...
Nĕhnanĕh kĕhgrĕună... nynăbythinnĕh...
The young emu... the little kangaroo....
tringĕh güggĕrră.... pўathinnĕh....
The little joey (sucking kangaroo)... the bandicoot....
nўnăbўthinnĕh-kōobrўnĕh... mārĕh tĕrrĕnnĕh...
The little kangaroo-rat... the white kangaroo-rat...
pўathinnĕh pungōothinnĕh... lōokōothinnĕh...
The little opossum... the ringtailed opossum...
mўtoppynĕh... trўnōonĕh...
The big opossum... the tiger-cat...
wathĕrrungĭnnă... mārĕh bunnă...
The dog-faced opossum... the black cat.

The verbal metres of the above Hunting Song, indicated by Walker's diacritics, could be sung, as are those of the Dance Song, to a 6/8 musical rhythm. And the suggestion here is that the Dance Song like the Hunting Song may also have been performed by a group of female singers in two parts, a vocal effect which Fanny Smith could not, of course, have achieved alone.

Written examples of "third parallels" indicate that in such singing the vocal range is usually no more than a fifth. This may be seen in one example from New Guinea, transcribed by Schneider (in Oxford History of Music 1957, p. 75, Ex. 126), and another from the West Carolines, by Herzog (in Sachs, 1962, p. 179, Ex. 72). In the present transcriptions of Fanny Smith's songs, where only Mrs. Logan's arrangement is encompassed by the fifth, a second part, if added one "third" above or below, would extend this range. Nevertheless it is not inconceivable that the Dance Song, like the Hunting Song, belonged to a melodic order customarily sung by Tasmanian aboriginal women in parallel thirds.

In the present paper pitch and duration graphs are used to compare Fanny Smith's melodies with samples recorded on the Australian mainland and elsewhere (cf. scale comparisons in Moyle, 1960, p. 78). Each linear unit represents the melodic outline of a previously notated song item. Pitch is reproduced vertically (one-twelfth of an inch to, approximately, a semitone); duration is reproduced horizontally (one-twelfth of an inch to a [notated] quaver, or eighth note). It will be noted that there are more quavers in Version C of the Dance Song than in the Spring Song. Quaver durations in the latter song are inexact and generally longer by comparison.

The octave span is represented by one inch. And the tonal level (or levels) with which the progression of vocal tones most often coincides is seen to emerge in the length and disposition of the horizontal lines. Western designations such as "tonic", "dominant" etc. are thus avoided. Vertical lines indicate "broad" (as against "narrow", or accurately measured) melodic steps or intervals.

The method is not new. Linear representations of various kinds have been used before for the purpose of melodic description. Pitch/duration graphs have the advantage here of directing attention to tonal movement, rather than to precise pitch. And if used in conjunction with the sound-recordings they may serve to emphasise important structural aspects which, as contended here, distinguish Fanny Smith's song samples (1899-1903) from others recorded in Central and South Australia during a period between 1930 and 1945.

Unlike the chosen Australian examples (nos. 6-9), which descend more or less directly from the highest note to the lowest, the melodic course seen in the graphs of the Tasmanian songs (nos. 1-4) is bi-directional. In each of Fanny Smith's items the commencing tone is followed by an ascent, which in turn is followed by a descent. The frequent tonal occupation of a pitch level about three semitones up suggests that at this point the "final" has been reached. But then follows a further drop to the lower octave level, and to a tone below, that is, to the "rising penultimate tone". The resulting division of the Dance Song melody into upper and lower sections is unlike that of the Spring Song where the lower division recurs more regularly, and like a formal melodic refrain. Despite the final descent in the Spring Song unmistakeable emphasis is given to a more central level, five-twelfths (or one fourth) up.

If the tone at the lower octave level in the Tasmanian examples is to be taken as the "tonic", as suggested (Ellis 1964, p. 345), it must then be admitted that, as such, it has not the same melodic function as in each of the accompanying Australian items. For instance, after this level has been affirmed (by repetition and short, appoggiatura-like descents) in the Bunganditj (Bungandidj) sample[10] there is an immediate rise, to a tone at the upper boundary. It would seem then that the "tonic", more strongly emphasised in the Australian examples, is also a sign for re-commencement of the main

(descending) melodic movement. Moreover, in any one Australian song "item", that is to say, in any of the characteristically brief, periodic sections of Australian singing, there may be more than one such melodic re-commencement. In the transcription of the Pitjantjara (Bidjandjadjara) item reproduced here[11] there are three descents, the third comparatively precipitant. In the Tangani (Danganegald) sample[12] there are four descents, the third and longest of which has two beginnings. In the well-known Aranda sample there are seven descents during the item recorded[13]. Apart from its frequency and duration this "tonic" or ground tone appears to have a definite structural potential in the samples of Central and South Australian singing. This is not so of tones at the lowest level in the songs of the Tasmanian singer, Fanny Smith.

In the contour graph of the Bungandidj item from Robe, South Australia, a marked terminal rise is clearly seen. This and certain of the rhythmic features, notably the anapaest patterning, link this "Song from Guichen Bay" to singing heard further east in New South Wales and north as far as central Queensland. A Song of Bennilong, from New South Wales, published by Mr. Edward Jones of London in 1811 (Bonwick 1870, p. 39)[14] makes interesting rhythmic and linear comparison with the Bunganditj sample (see Transcriptions nos. 6 and 11). The terminal rise in the "Australian Song" (1825) notated (Transcription no. 10) by Barron Field may be the melodic re-commencement; and the text here seems oversimplified.[15] According to Bonwick *(op. cit.)* some of the vocal terminations heard in Tasmania consisted of a "Whoo or screech" which occurred "an octave above the keynote". But in the Tasmanian songtext by R. W. Davies quoted above, the vocal termination, "hoo hoo" is described as "very guttural", which may mean low-pitched. Without recordings of the actual sounds attempts to compare terminal effects such as these are not profitable.

Clearer distinctions are to be made between the tone and text relationships in Fanny Smith's songs and the few that have been recorded (with audible songtexts) in southern parts of Australia. By examining the words as they occur in the progression of the melody, it will be noted that recognisable text units occupy much the same position and duration in versions of the Tasmanian Dance Song melody. See, for instance, the words "pallawoo, pallawoo" in Versions A, B and C. And except at the beginning of the song, other verbal/musical correspondences heard in the 1899 recording are maintained in 1903. A similar type of correspondence is not usual in Australian singing. The same words may appear in any part of an Australian melody or tonal descent, at the beginning, middle or end. There are important exceptions, however, such as the Aranda "Rat" Song. Central Australian aboriginal songtexts, usually consisting of two distinguishable verbal units, maintain a strict sequence independent of the different tone levels in the melodic rise and fall. Taken together the text units are generally of shorter duration than the full tonal, or melodic, content of the song item; consequently, there is proportionately more verbal than melodic repetition.

In the Bungandidj sample it will be noted that, unlike the other Australian examples, the words "Guichen Bay" (Kutjun-bei) are reserved for tho lowest (as well as the uppermost) terminating tones. These words date from the post-European period (Tindale 1941, p. 236). It is possible that the inclusion of the place-name "Guichen Bay" may have disturbed an older text sequence.

To return to linear aspects of melodies under discussion a pendular movement will be noted in the graphs (nos. 4 and 5) of both the Spring Song and the Hymn Improvisation (mentioned above). Up-and-down movement of the vocal tones is also to be seen in contours of three songs (see Transcriptions and Graphs Nos. 12-14) recorded in the Solomon Islands.[16] In two of the samples there is a marked tendency to return to a central level. By comparing transcriptions of these appended items it will be seen that there are other, possibly transitory, melodic features which are not shared with the Spring Song and Hymn as sung by Fanny Smith. All that can be said here of tone/text relations in the two Solomon Island samples is that they do not follow the general Australian principle outlined above.

A systematic survey of recorded song remnants in South (and South-east) Australia still remains to be made, and with the Tasmanian samples in view. Compared with songs reeorded on the mainland more differences than similarities have been found in the present study of Fanny Smith's songs. Fanny Smith's Spring Song and Hymn Improvisation show some structural resemblance to a style of singing hitherto observed in parts of Melanesia. And if the early evidence for singing in "third parallels" be accepted, further support is thus given to a tentative theory of musical connection between Tasmania and places in the South Pacific.

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THE RECORDINGS AND CONTENTS

The Tasmanian recordings of Mrs. Fanny Smith contain songs and spoken announcements. Full transcriptions of the latter appear below and are numbered. The former are referred to here as Dance Song (Versions A, B or C) and Spring Song (Versions A or B). In the following list of eight cylindrical records now held in the Tasmanian Museum, Hobart, a duplication of material will be noted. This arises from the fact that some of the cylinders (and mended fragments of cylinders) are copies of originals also retained. The quoted comments regarding the conditions of the cylinders held in the Tasmanian Museum are those of M. J. Longman (1960). In 1953 the contents of four of the cylinders were transferred by the Australian Broadcasting Commission to a disc entitled: "Songs

and War Chants of Extinct Tasmanian Aborigines" (see below). Recordings indicated by an asterisk are those reproduced on a seven inch (45 RPM) disc recently issued by the Royal Society of Tasmania.

*Record 1. Contents: Announcement No. 1

DANCE SONG VERSION A

Recorded in the Rooms of the Royal Society of Tasmania on 5th August, 1899.

(Museum No. 15685/M3317)

The inferior sound quality of the original cylinder, "unbroken but in poor condition", hinders transcription of speech and song words. The recorded duplicate made by the Museum in 1959 is approximately a minor third lower in pitch than the same song duplicated on disc by the ABC.

*Record 2. Contents: Announcement No. 2

SPRING SONG VERSION A

Recorded in the Rooms of the Royal Society of Tasmania on 5th August, 1899.

(Museum No. 15686/M3318)

Music transcription of this version of the Spring Song has not been attempted due to surface scratch and the loud, regular noises of "the large cracks in this record".

*Record 3. Contents: Announcements Nos. 3 (a, b, & c).

Recorded in the Rooms of the Royal Society of Tasmania on 5th August, 1899.

(Museum No. 15687/M3319)

"Although this record is unbroken, it is in very poor condition".

Record 4. Contents: Announcement No. 4(a)

DANCE SONG VERSION B

Announcements Nos. 4 (b & c)

Recorded by Horace Watson at his home, Barton Hall, Sandy Bay, Hobart, Tasmania on 10th October, 1903.

(Museum No. 15688/M3320)

This recording is of relatively good quality.

Record 5. Contents: Announcement No. 5(a)

SPRING SONG VERSION B (incomplete)

Recorded by Horace Watson at his home, Barton Hall, Sandy Bay, Hobart, Tasmania on 8th October, 1903.

(Museum No. 15689/M3321)

"A large piece broken off the cylinder has been lost".

Record 6. Contents: Announcement No. 4(a)

DANCE SONG VERSION C

Announcement No. 5(a)

SPRING SONG VERSION B (incomplete)

Recorded by Horace Watson at his home, Barton Hall, Sandy Bay, Hobart, Tasmania on 10th October, 1903.

(Museum No. 15690/M3322)

This cylinder which has since been repaired, was found shattered into six large pieces and many fragments. Despite noise of the surface crack and pre-echo, possibly from incorrect tracking of the stylus, it has been possible to identify the first song as Version C of the Dance Song. This song is preserved in better condition on the disc transcription by the Australian Broadcasting Commission in 1953, see below.

*Record 7. Contents: Announcement No. 5(a)

SPRING SONG VERSION B

Announcement No. 5(b)

Phonograph copy of Record No. 5, presumably made by Horace Watson.

(Museum No. 15691/M3323)

"Made from hard black material similar to commercial records, this cylinder is complete and in good condition".

*Record 8. Contents: Announcement No. 6(a)

HYMN IMPROVISATION.

Announcement No. 6(b)
Announcement No. 6(c)

Phonograph copy by Horace Watson of a recording made in 1903.

(Museum No. 15692/M3324)

"This cylinder has one crack along its entire length and another at the beginning".

1953 Disc (16" standard groove 33 1/3 RPM)[17]

"Songs and War Chants of Extinct Tasmanian Aborigines" Nat.1(NA24504A,FSZ2658)

This processed disc by the Australian Broadcasting Commission contains selections from the above cylindrical material in the following order:-

Cut 1. Announcement No. 1 (commences from the word . . . ."Tasmanians")

DANCE SONG VERSION A

The original cylinder was revolving at a speed faster than normal during the preparation of this copy.

Cut 2. Announcement No. 4(a)

DANCE SONG VERSION B

Announcement No. 4(b)

Announcement No. 4(c) (up to the words "East Coast Tribe")

Cut 3. Announcement No. 4(a)

DANCE SONG VERSION C

Announcement No. 5(a)

SPRING SONG VERSION B (incomplete)

Cut 4. Announcement No. 5(a)

SPRING SONG VERSION B

Announcement No. 5(b)

The material on the above disc corres-

ponds with that of four recordings held in the Tasmanian Museum:

Cut 1. equivalent to Record 1 (15685/M3317)
Cut 2. „ „ 4 (15688/M3320)
Cut 3. „ „ 6 (15690/M3322)
Cut 4. „ „ 7 (15691/M3323)

The present series of transcriptions (announcements, song words and music notations) have been made after aural comparison between material heard on the tape and disc copies listed above, also on an experimental, or laboratory, tape copy also lodged in the Tasmanian Museum.

Transcriptions of Announcements (after Longman) (as heard on the Fanny Smith Phonograph Recordings, 1899 and 1903).

The following transcriptions of spoken announcements heard on the Fanny Smith recordings, have been numbered for reference. For less clear passages some of the interpretations given here differ from those of Longman (1960). Words appearing in brackets are still uncertain.

No. 1. Spoken by Mrs. Fanny Cochrane Smith.

"I'm Fanny Smith. I was born on Flinders Island. I'm the last of the Tasmanians. I'll (put this morning) a very long story about it. I'll tell you the truth, to let you know a little about us. My mother's name was Tanganitara.[18] I — we are some true born sisters from Flinders Island, where we were for seven years. And I'm here speaking to-day."

Presumably in answer to a question . . . "have we got for mother and my father? My father [or family?] Noona. Noona (nitara-noota). (Sing a song. Noota, mother and me). My father Noona. My father was a (whaler). Lose-a my mother, all gone."

Presumably in answer to another question . . . "My family? I'm married. Goodbye. My father [or family?] no more.

No. 2. Spoken by Mrs. Fanny Cochrane Smith.

"It's Spring time,
The birds is whistling,
The spring is come,
The flowers are all budding, (Longman: The clouds are all sunny)
The (red) fuschia is on the top,
Birds are whistling,
Everything is pretty
'cause it's spring,
(The birds are still dancing)
For the springtime."

No. 3. (a) Spoken by Mr. J. B. Walker F.R.G.S.[19]

(Longman has identified the speaker here as the Bishop of Tasmania).

"It has been my great privilege to-day, the fifth of August, 1899 to have witnessed Mrs. Fanny Smith of Port Cygnet, who claims to be the last member of all the native races of this island, sing and speak into the gramophone. I have also taken a photograph showing her sitting by the machine. I feel very glad indeed that the aboriginal language of this island, together with its songs, however fragmentary the results may be, have at last been permanently registered and can be preserved and listened to in future years, when this and the remaining representatives of the native race have passed away. I think the Secretary of this Society, the Royal Society of Tasmania, Mr. Alexander Morton, is deserving the thanks of scientific men and all true colonists for bringing about such a valuable and unique contribution to the records of this colony. J. W., Government(?) . . . .".

(b) Spoken by Robert M. Johnston, Registrar General of Tasmania.

"I, Robert M. Johnston, Registrar General of Tasmania, have also the great privilege and pleasure of hearing the songs of the native Tasmanians sung by the last of themselves in the way of the phonograph. This must be of the greatest interest to those who are studying the various races of mankind now".

(c) Spoken by Alexander Morton, Secretary of the Royal Society of Tasmania.

"Alexander Morton, Secretary of the Royal Society of Tasmania, endorses that same thought of R. M. Johnston, Vice-President of the Royal Society, in having had the pleasure of listening to the songs and words of Mrs. Fanny Smith, who claims to be the last of the Tasmanian aborigines. These songs and words have been recorded in the Royal Society's Rooms, Hobart, Tasmania on Saturday the fifth of August in the presence of His Lordship, the Bishop of Tasmania, the Rev. H. H. Montgomery, Mr. J. B. Walker, F.R.G.S., Mr. R. M. Johnston (Editor)".

No. 4. (a) Spoken by Horace Watson of Sandy Bay.

"This record by Fanny Smith, daughter of Tanganitara, gives us the song of the natives when holding their corroboree. The lubras generally sing with all their might, accompanied by the beating of sticks and skins. This is a dance song by Fanny Smith".

(b) "This record was taken on October the tenth, 1903, by Horace Watson, Sandy Bay, Hobart, Tasmania".

(c) Spoken by Fanny Cochrane Smith.

"I am the last of the race of Tasmanians. I'm - I'm the daughter of Tanganitara, the East Coast Tribe. My mother belonged to the East Coast Tribe . . . I am just seventy years of age".

No. 5. (a) Spoken by Horace Watson of Sandy Bay.

"This record of Mrs. Fanny Smith, sister of Mary Ann, the wife of Walter Arthur and daughter of Tanganitara, gives us the song of the aborigines at the time of the spring, welcoming the advent of birds and flowers".

(b) "This record was taken on October the eighth, 1903, by Watson, Barton Hall, Sandy Bay, Tasmania".

(c) "This record was taken off the original . . ." (following copy of the above).

No. 6. (a) Spoken by . . . (The voice differs in accent from Horace Watson's).

"This record sung by Fanny Smith, the daughter of Tanganitara of the East Coast Tribe.

Praise the Lord,
Hail the Lord,
Abide in Heaven above".

(b) "This record was done for me by Fanny Smith in 1903. We had a real excellent time here. You will see the photograph taken in the very action of singing".

(c) Spoken by Horace Watson (following copy of the above).

"This record was taken from the original on May the sixth, 1909, for Mr. Robert Hall, Curator of the Tasmanian Museum, by Horace Watson, Sandy Bay".

NOTES

1. Prior to the Symposium, Mr. N. B. Tindale informed me of a text written down for a Tasmanian song which he heard on Cape Barren Island in 1949.

2. Mrs. Logan arrived in Tasmania from London on 12th February, 1835. Later she became the organist at St. David's Cathedral and taught music in the Colony. In 1839 she arranged the song "The Vows that Breathed in Solitude", allegedly the first Tasmanian song. In the 1842 census it is stated that she was the mother of 4 sons and a daughter. At that time her address was 20 Macquarie Street, Hobart.

   Some doubt has been cast on the identity of the arranger of this song. Mr. N. J. B. Plomley believes that it may have been Mr. Logan, a librarian at the circulating library in Hobart Town. He kindly supplies the following entry from the diary of George Augustus Robinson, dated 22nd October, 1836:

   > "Spent the evening at Logans in Macquarie Street. Mr. Logan set to music a song of the Aborigines POPELLER, etc. The first ever attempted."

   Mr. Plomley maintains that on the evidence of opportunity the song could have been obtained from the Aborigines between August, 1834 and September, 1835. If Mr. (not Mrs.) Logan "arranged" the song (i.e. set the vocal part to piano accompaniment) one may assume that Mrs. Logan was at least the better musician, for the "arrangement" is inexpertly done. If the Logans both arrived in Tasmania together the date of this manuscript would be some time after February and probably before September 1835. See also Note 9a.

3. In a paper entitled Aboriginal Music and the Recording Machine read during the ANZAAS Congress (Section F) in Canberra, 1964.

4. Historical Library, Forbes St., Sydney, New South Wales. ABC Cat .No. NAT 13 (16" disc 33 1/3 RPM).

5. History Library as above. ABC Cat. No. NAT 1. (N.A. 2450A FSZ2658). 16" disc, 33 1/3 RPM.

6. The Intervallic Structure of Australian Aboriginal Singing. (Unpublished M.A. Thesis, 1957). Transcriptions Nos. 56-58.

7. In Milligan's Vocabulary (for the Tribes about Mount Royal, Brune Island etc.) the meaning of Riawe' is given as "sport".

8. Dr. A. Capell's spelling of the same word is palawa.

9. During the Symposium on the Tasmanian Aborigines (ANZAAS, 1965), when slides of the present transcriptions were shown and song recordings played, Dr. A. Capell affirmed that words appearing in the (hypothetical) text of the Spring Song were recognisably Tasmanian.

9a. Mr. W. F. Ellis suggests that the endorsement "Done by Mifs [Miss?]" (which he thinks may have been in the handwriting of James Backhouse) is intended to convey that the song was transcribed by a Miss Logan.

10. Recorded by N. B. Tindale in 1937. The song was sung by Mllerum (Clarence Long), whose early life was spent among the aged people of the Tanganekald (Tangane Tribe) in the unsettled country near Salt Lake on the Coorong (Tindale 1937, p. 107).

11. Transcription No. 26(a) in The Intervallic Structure of Australian Aboriginal Singing, M.A. Thesis, 1957. An item from a Pitjantjara (Bidjandjadjara) song series (Kangaroo of Malupiti) recorded in Central Australia by T. G. H. Strehlow who transcribed the text.

12. Transcribed in 1959 from a tape transfer of wax cylinder recordings by R. M. Berndt (1943) in East Wellington and Upper River Murray, South Australia. In this sample the tempo is notably slower than in others belonging to the same collection.

13. See Song No. 2 ("Rat") in the series entitled "Australian Aboriginal Song" recorded and annotated by E. Harold Davies on three discs (PRX-11, Columbia Graphaphone (Aust.) Ltd.) published (1930s) by the Board of Anthropological Research, University of Adelaide. A transcription of the same song (without text) appears in Davies (1927). Present text (in transcription No. 9) supplied by T. G. H. Strehlow.

14. Transcription No. 11 Clef, double bar-lines and other notational signs have been taken from the transcription published by Bonwick (op. cit. p. 33). It was first published by Edward Jones in "Musical Curiosities" and said to be from a love-song sung by Beonelong and Yamroweng on their visit to England at the beginning of the 19th century.

15. Transcription No. 10. This "Australian Song" was reproduced by Bonwick (1870, p. 31) with the following explanatory note: In 1825 Mr. Barron Field of Sydney published the following song of the New South Wales natives, which was said at the time to be very similar in sound to some Tasmanian chants. Referring to Bonwick's note Wallaschek remarked (1893, p. 40) that it would be desirable to quote the original "so that one might ascertain the exact resemblance". The "true Tasmanian tune of the oldest date" which Bonwick quotes and attributes to Captain Freycinet is, as H. Ling Roth points out, incorrectly identified. Freycinet's notation, a short repeated descending passage encompassing the fourth, is of a Kangaroo dance song from Port Jackson, New South Wales.

16. The two songs by Isaac Iripu, of Siwai area in South Bougainville, were tape-recorded in 1960 by the Rev. A. H. Hall, Goldie College, Banga. The song text was written by Isaac, a student of the College. The third song, Tsegul, "sung by a young man as he draws in the sand", was recorded by Ray Sheridan on Buka Island, British Solomoons. Disc recording (Wattle Archive Series No. 2) Side 2 Band 7a.

17. Redubbed by the ABC from the same material as on the disc. Nat. 13.

18. In Milligan's Tasmanian Vocabulary (1855, p. 272) there is a list of women which includes "Tacnghanootera (literally — weeping bitterly) a native of George's River".

19. James Backhouse Walker (1841-1899), a member of the firm of solicitors, Walker and Wolfhagen, was admitted as a barrister in Tasmania, in 1876. He was also Vice-Chancellor of the University of Tasmania, a Trustee of the Tasmanian Library, a member of the Council of the Royal Society of Tasmania, and a constant contributor to the Society's Journal.

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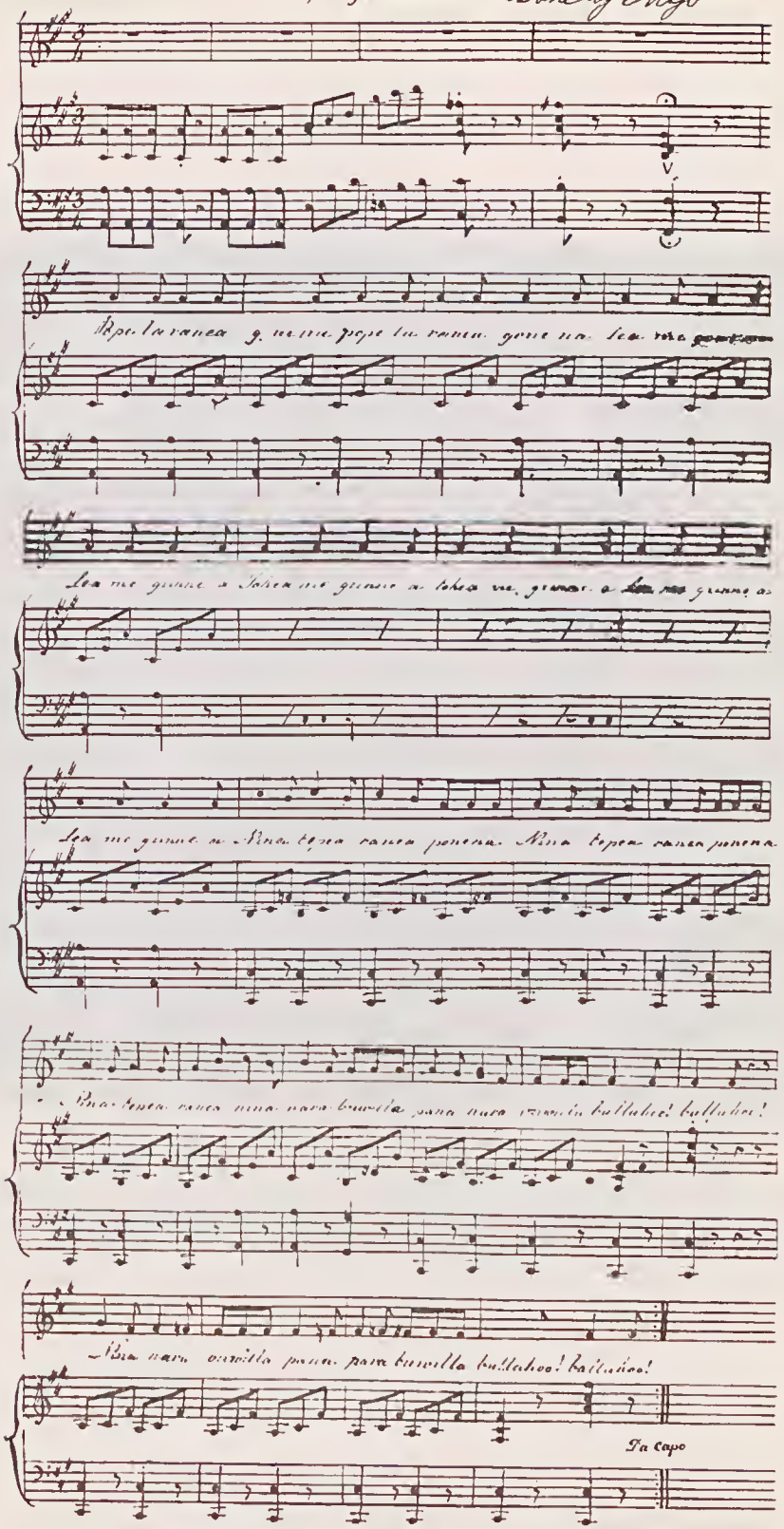
* Mrs Fanny Cochrane Smith and Horace Watson, at the latter's residence in Sandy Bay, Hobart, 10th October, 1903.

EDITORIAL NOTE

Slight damage to the original manuscript of Mrs. Logan's transcription has obscured the first crotchet in bar 6 and confused parts of the bass line in bars 10 and 11.

Mrs Logan's arrangement (ca. 1840) for voice and piano accompaniment of the Dance Song, also known as the "Song of the Ben Lomond tribe" or "Song of a Great Chief".

SONG of the ABORIGINES of VAN DIEMAN'S LAND

Arranged by Mrs. LOGAN Done by Miss

Repe la vanea g. ne ma pope la vanea gone na lea ma
Lea me gonne a Tokea me gonne a tokea me gonne a
Lea me gonne a Nina topea vanea ponena Nina topea vanea ponena
Nina topea vanea nina nara bunella pana nara
Nina nara ouwella pana para bunella ballahoo! ballahoo!
Da Capo

* Mrs. Fanny Cochrane Smith and members of the Royal Society of Tasmania, in the Royal Society's rooms, 5th August, 1899. (See Transcriptions of Announcements No. 3). Left to right: Mr R. M. Johnson (seated), Mr J. W. Beattie, Mr Fisher, Superintendent J. Cook, Mr Alexander Morton, Mr James Backhouse Walker, Mrs Fanny Smith and nephew.

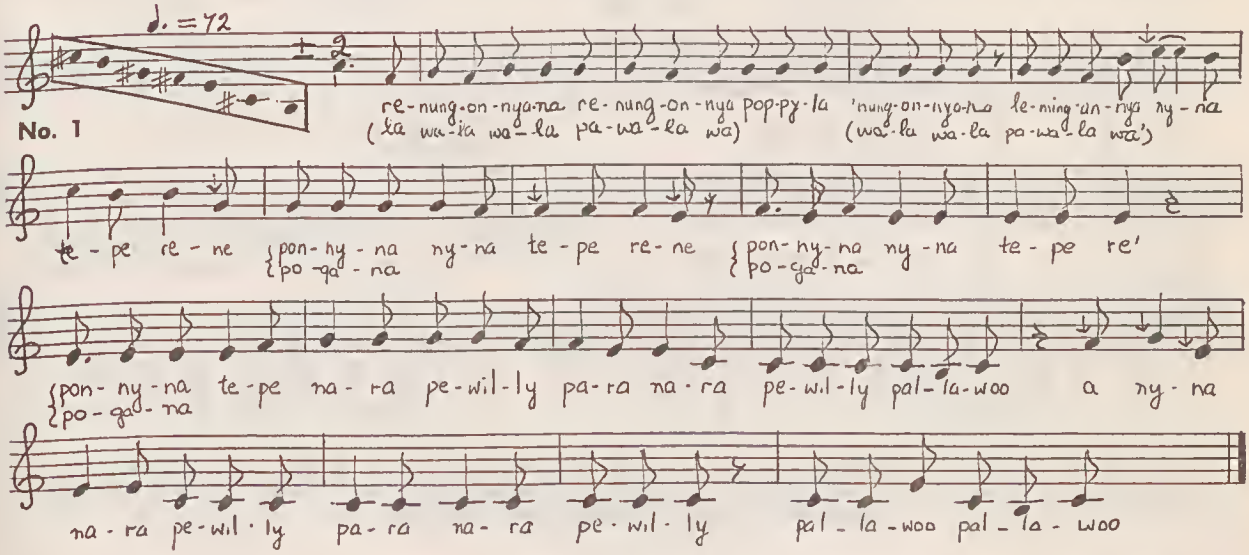
PHOTOGRAPHS—By courtesy Royal Society of Tasmania and the Tasmanian Museum and Art Gallery.

MUSIC NOTATIONS

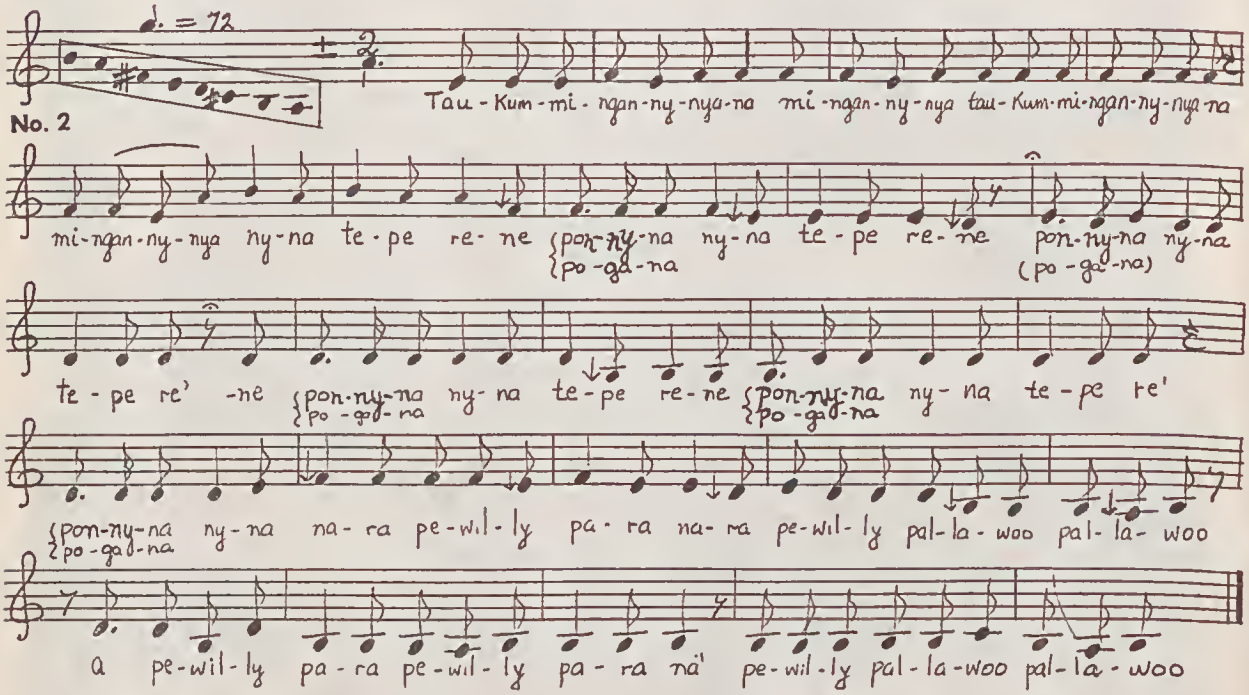
Nos. 1 - 5 have been transcribed by the writer from the Tasmanian recordings of Fanny Cochrane Smith, Nos. 6 - 9 from recordings more recently made in South and Central Australia, and Nos. 12 - 14 from recordings of songs from the Solomon Islands in the South Pacific. Nos. 10 - 11 represent impressions of East Australian aboriginal singing written down before the time of the first recording machines by Barron Field and Edward Jones.

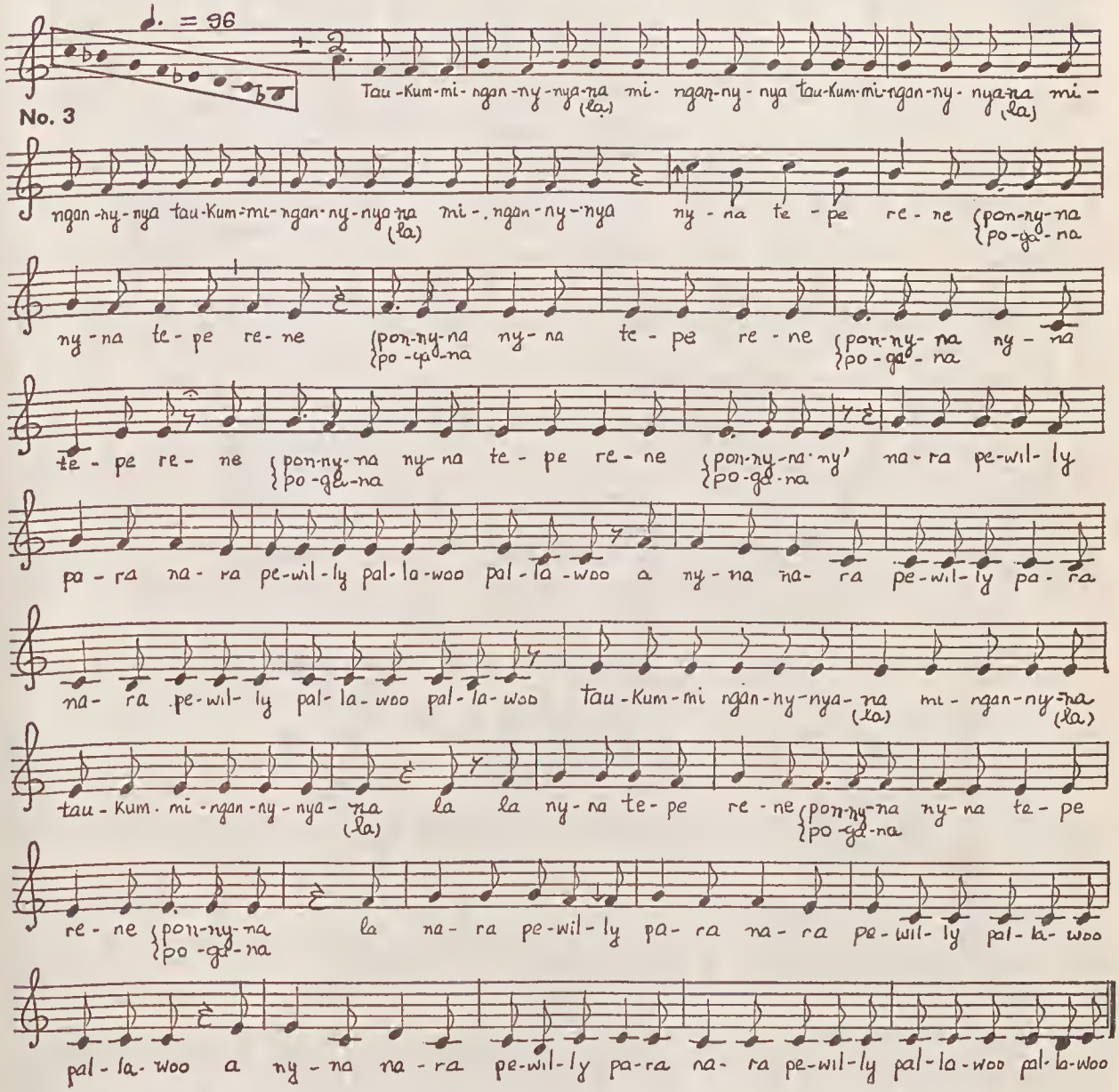
In place of a 'key signature' at the beginning of each item there is a scale, or graded inventory of notated pitch symbols. This prefixed abstract does not imply a fixed tuning, or 'temperament'. An arrow placed near a note indicates, according to its direction, a rise or fall in the estimated level of pitch. The fall in vocal pitch towards the end of the Hymn (No. 5) is closer to a change in pitch level; accordingly, a second pitch series has been prefixed.

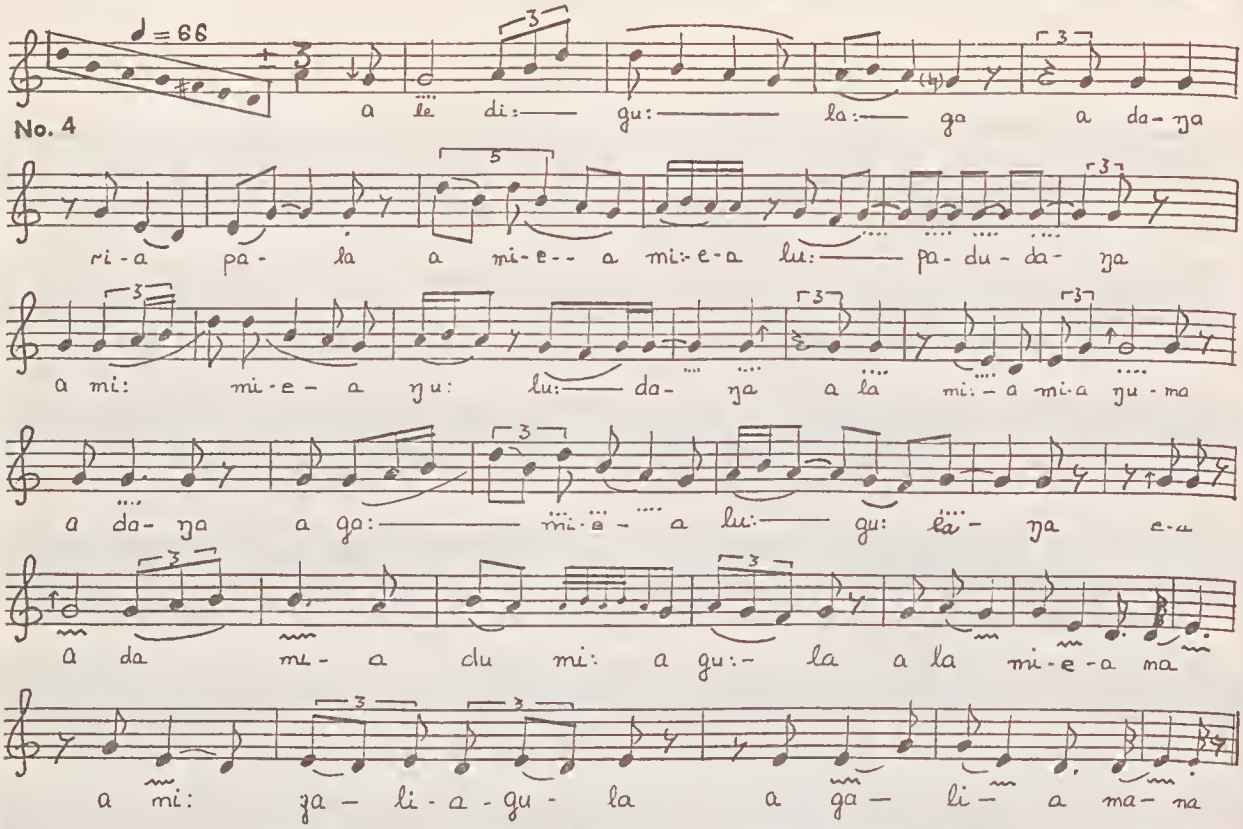
Where the singer does not adhere strictly to an established rhythm, a plus and minus sign is placed before the time signature (Nos. 1 - 5 and 7). Where asymetrical measures are an integral part of the song's rhythm, a combination signature is given (No. 13). Vocal sounds without definite pitch are written as x (No. 6). Pulsations, or glottal tremors, are indicated by dots placed under the notated tones. Vocal vibratos, or 'tremolos', are indicated by short wavy lines. A slanting line, connecting two notes of different pitch, indicates a slide, or vocal glissando.


No. 1
re-nung-on-nya-na re-nung-on-nya pop-py-la 'nung-on-nya-na le-ming-an-nya ny-na
te-pe re-ne pon-ny-na ny-na te-pe re-ne pon-ny-na ny-na te-pe re'
pon-ny-na te-pe na-ra pe-wil-ly pa-ra na-ra pe-wil-ly pal-la-woo a ny-na
na-ra pe-wil-ly pa-ra na-ra pe-wil-ly pal-la-woo pal-la-woo

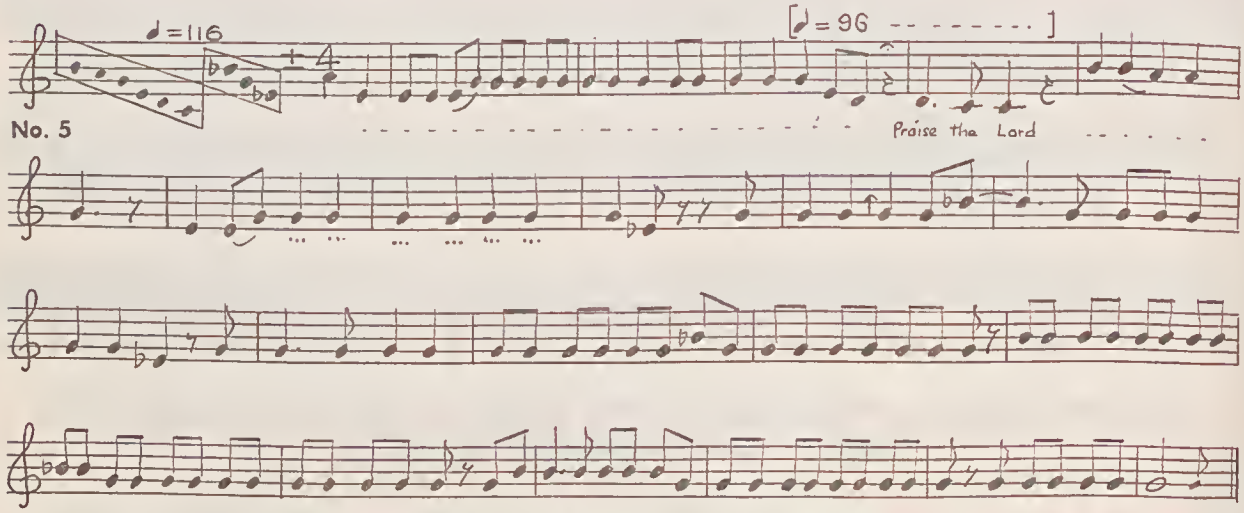
Dance Song (Version A), or 'Song of the Ben Lomond tribe', recorded by the Royal Society of Tasmania in 1899. Song text (Tasmania) after G. W. Walker. Attempts have been made, not always successfully, to reconcile words in Walker's text with those heard in the sound recordings of the Dance Song. (Tape transfer from Cylinder No. 15685/M3317, Tasmanian Museum; and disc, issued 1967, "Fanny Cochrane Smith. Songs and Speech" TRS-1683 (45 RPM), Side 1; Band 1b, *Royal Society of Tasmania).* Duration: 33".


No. 2
Tau-Kum-mi-ngan-ny-nya-na mi-ngan-ny-nya tau-Kum-mi-ngan-ny-nya-na
mi-ngan-ny-nya ny-na te-pe re-ne pon-ny-na po-ga-na ny-na te-pe re-ne pon-ny-na ny-na (po-ga-na)
te-pe re' -ne pon-ny-na po-ga-na ny-na te-pe re-ne pon-ny-na po-ga-na ny-na te-pe re'
pon-ny-na po-ga-na ny-na na-ra pe-wil-ly pa-ra na-ra pe-wil-ly pal-la-woo pal-la-woo
a pe-wil-ly pa-ra pe-wil-ly pa-ra na' pe-wil-ly pal-la-woo pal-la-woo

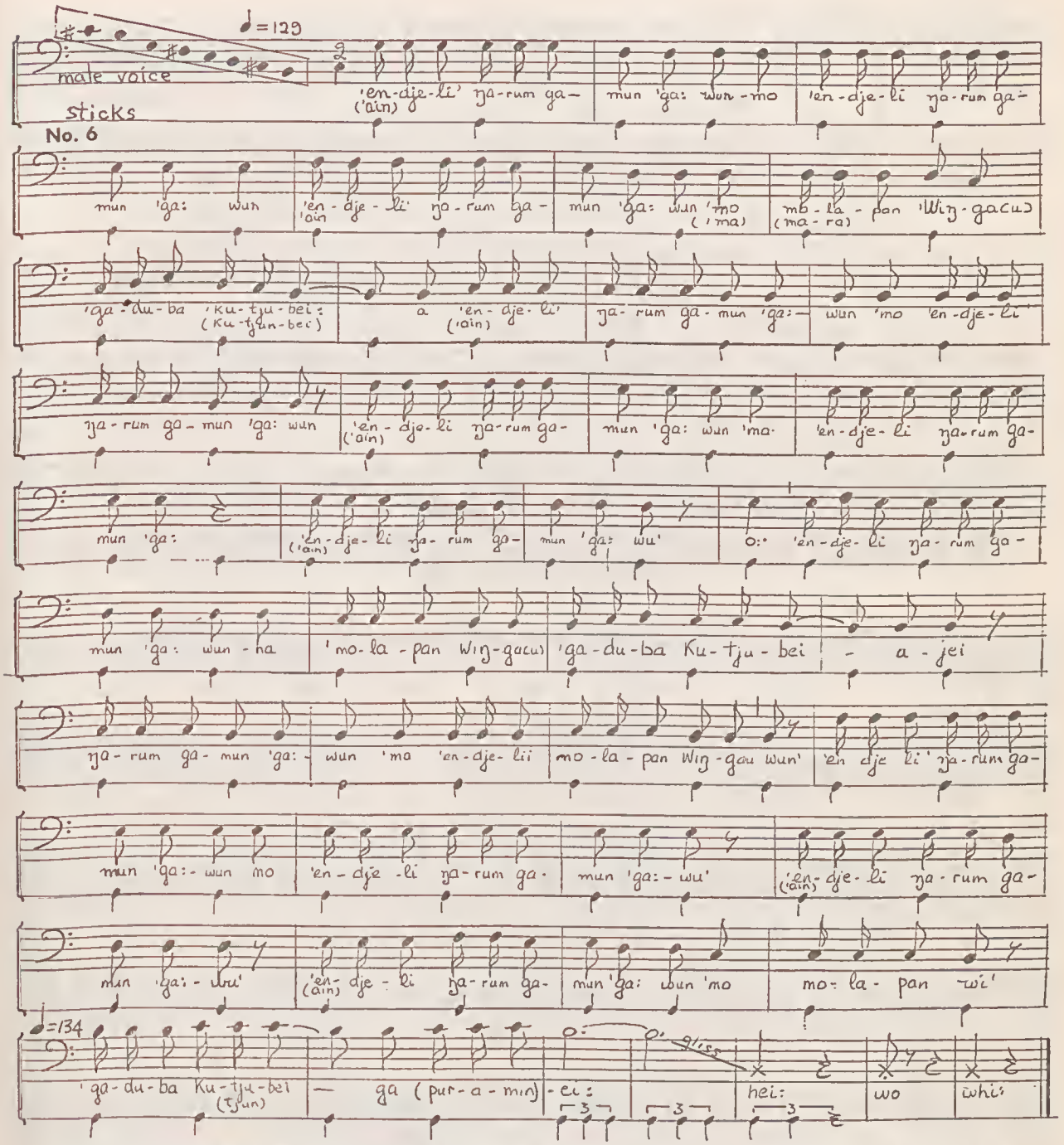
Dance Song (Version B), recorded by Horace Watson in 1903. Song text after G. W. Walker. (Tape transfer from Cylinder No. 15688/M3320, Tasmanian Museum; and disc NA 24504A, Band 2, *Australian Broadcasting Commission).* Duration: 42".

No. 3
♩. = 96
Tau-Kum-mi-ngan-ny-nya-na (la) mi-ngan-ny-nya tau-Kum-mi-ngan-ny-nya-na (la) mi-
ngan-ny-nya tau-Kum-mi-ngan-ny-nya-na (la) mi-ngan-ny-nya ny-na te-pe re-ne {pon-ny-na {po-ga-na
ny-na te-pe re-ne {pon-ny-na {po-ga-na ny-na te-pe re-ne {pon-ny-na {po-ga-na ny-na
te-pe re-ne {pon-ny-na {po-ga-na ny-na te-pe re-ne {pon-ny-na {po-ga-na ny' na-ra pe-wil-ly
pa-ra na-ra pe-wil-ly pal-la-woo pal-la-woo a ny-na na-ra pe-wil-ly pa-ra
na-ra pe-wil-ly pal-la-woo pal-la-woo tau-Kum-mi ngan-ny-nya-na (la) mi-ngan-ny-na (la)
tau-Kum-mi-ngan-ny-nya-na (la) la la ny-na te-pe re-ne {pon-ny-na {po-ga-na ny-na te-pe
re-ne {pon-ny-na {po-ga-na la na-ra pe-wil-ly pa-ra na-ra pe-wil-ly pal-la-woo
pal-la-woo a ny-na na-ra pe-wil-ly pa-ra na-ra pe-wil-ly pal-la-woo pal-la-woo

Dance Song (Version C), recorded by Horace Watson in 1903. Song text after G. W. Walker. (Tape transfer from Cylinder No. 15690/M3322, Tasmanian Museum; and disc No. 24504A, Band 3, *Australian Broadcasting Commission.)* Duration: 60".

No. 4
a le di:— gu:— la:— ga a da-ŋa
ri-a pa- la a mi-e-- a mi:-e-a lu:— pa- du- da- ŋa
a mi: mi-e- a ŋu: lu:— da- ŋa a la mi:-a mi-a ŋu-ma
a da- ŋa a ga:— mi-e- a lu:— gu: la- ŋa e-a
a da mi- a du mi: a gu:- la a la mi-e-a ma
a mi: ŋa- li-a-gu- la a ga— li— a ma- na

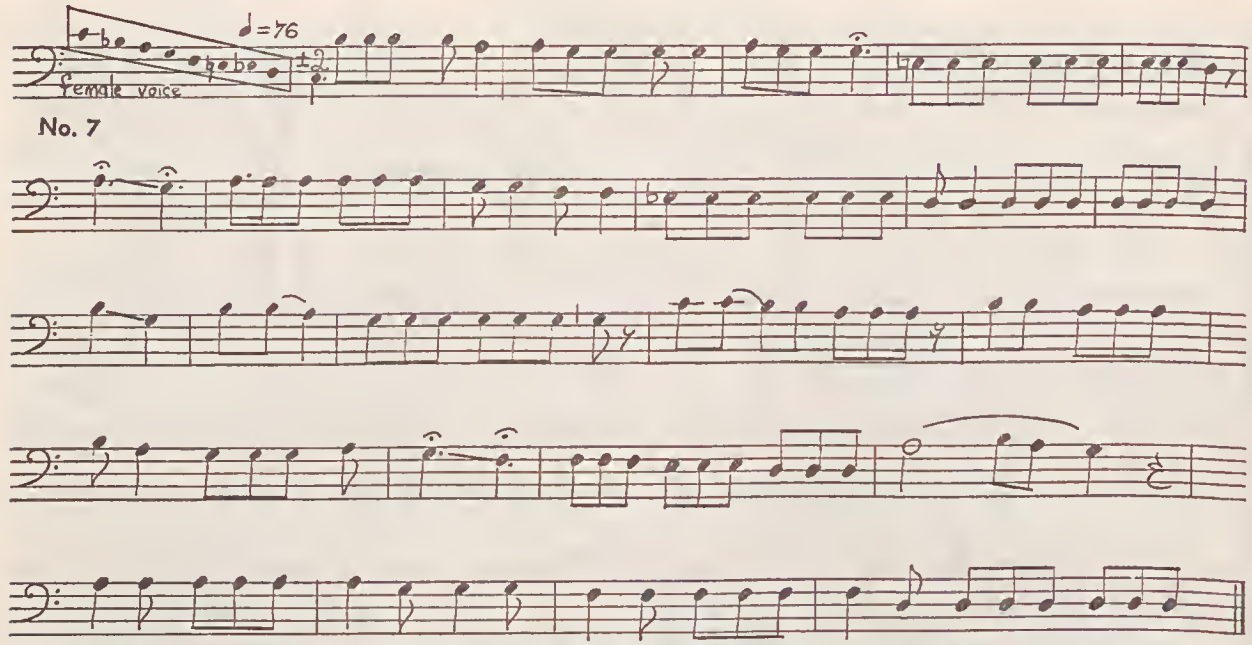
Spring Song (Version B), recorded by Horace Watson in 1903. Song text (auditory). (Tape transfer from Cylinder No. 15691/M3323, Tasmanian Museum; and disc, issued 1967, "Fanny Cochrane Smith. Songs and Speech" TRS-1683 (45 RPM), Side 2, Band 1, *Royal Society of Tasmania.)* Duration: 1' 27".



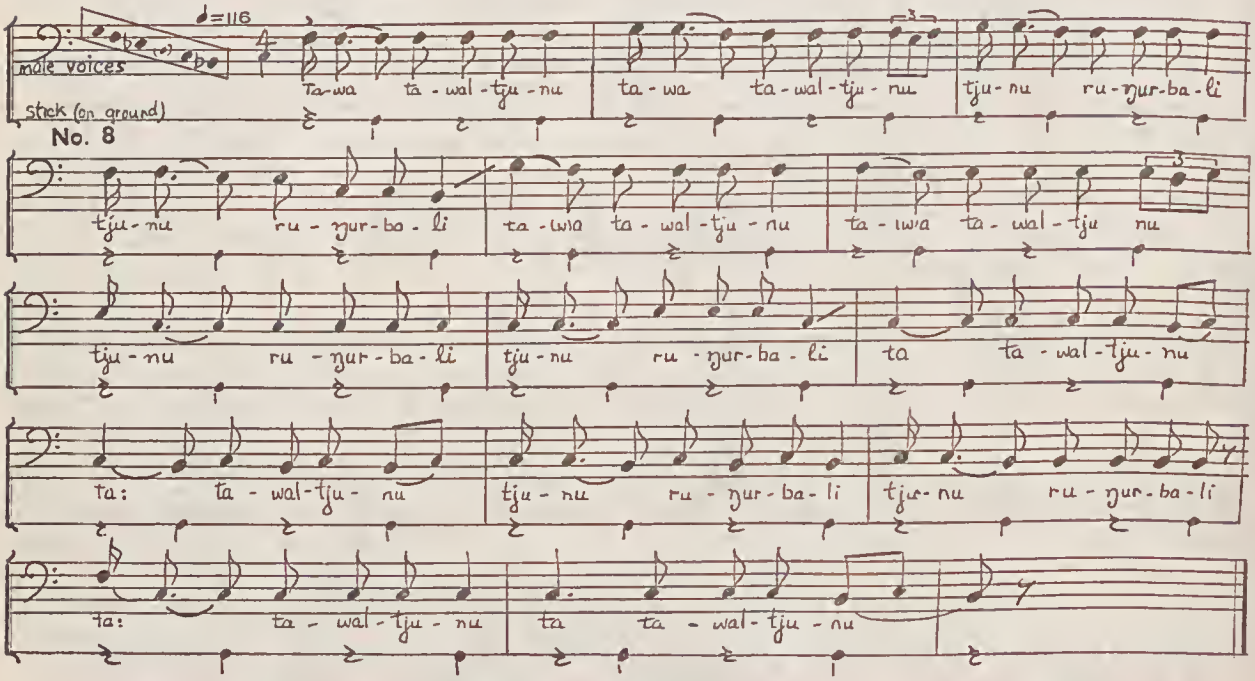
Hymn (Improvisation), first recorded in 1903, re-recorded by Horace Watson in 1909. (Tape transfer from Cylinder No. 15692/M3324, Tasmanian Museum; and disc, issued 1967, "Fanny Cochrane Smith, Songs and Speech" TRS-1683, Side 1, Band 2, *Royal Society of Tasmania.*) Duration: 52"

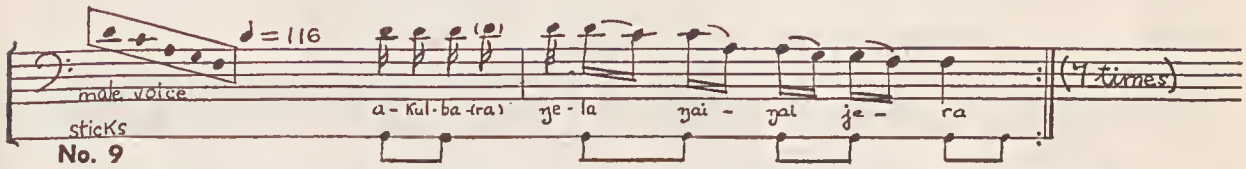


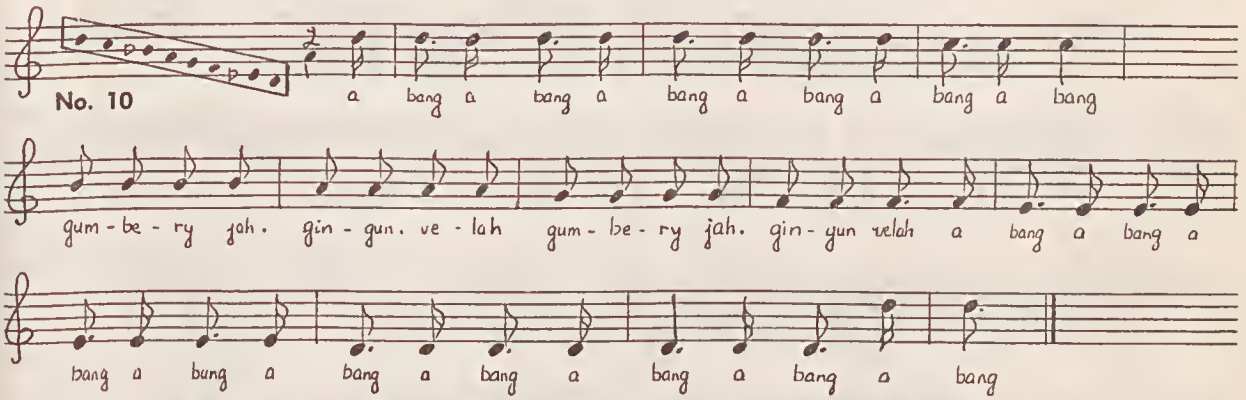
Song of Guichen Bay, recorded by N. B. Tindale in 1937. Song text (Bunganditj) transcribed by N. B. Tindale. (Disc No. 4, Clarence Long Series, unreleased, South Australian Museum.). Duration: 41".



Tangane (Danganegald) Song, recorded by R. M. Berndt in 1943. Song text inaudible. Duration: 52". (Tape transfer from cylinder, Ethnomusicology Section, Department of Music, Monash University, Victoria.). Duration: 52".

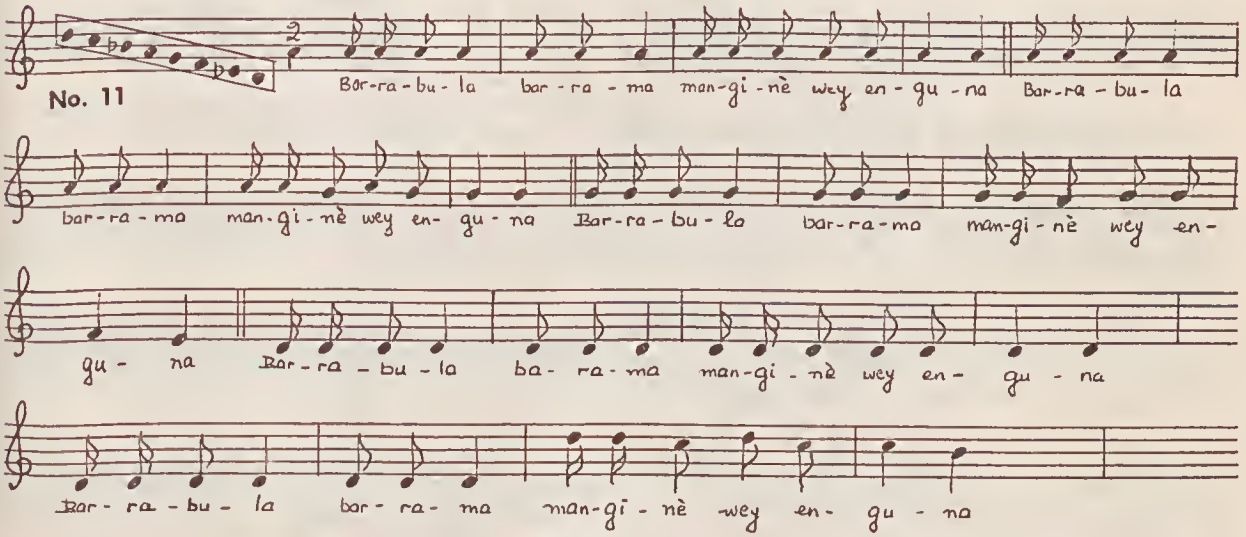

♩=116
male voices
stick (on ground)
No. 8
Ta-wa ta - wal - tju - nu
ta - wa ta - wal - tju - nu
tju - nu ru - ŋur - ba - li
tju - nu ru - ŋur - ba - li
ta - wa ta - wal - tju - nu
ta - wa ta - wal - tju nu
tju - nu ru - ŋur - ba - li
tju - nu ru - ŋur - ba - li
ta wa ta - wal - tju - nu
ta: ta - wal - tju - nu
tju - nu ru - ŋur - ba - li
tju - nu ru - ŋur - ba - li
ta: ta - wal - tju - nu
ta ta - wal - tju - nu

From the Kangaroo of Malupiti series, recorded by T. G. H. Strehlow in 1950. Song text (Pitjantjara) transcribed by T. G. H. Strehlow. (Disc recording, unreleased, University of Adelaide, South Australia.). Duration: 32".

No. 9

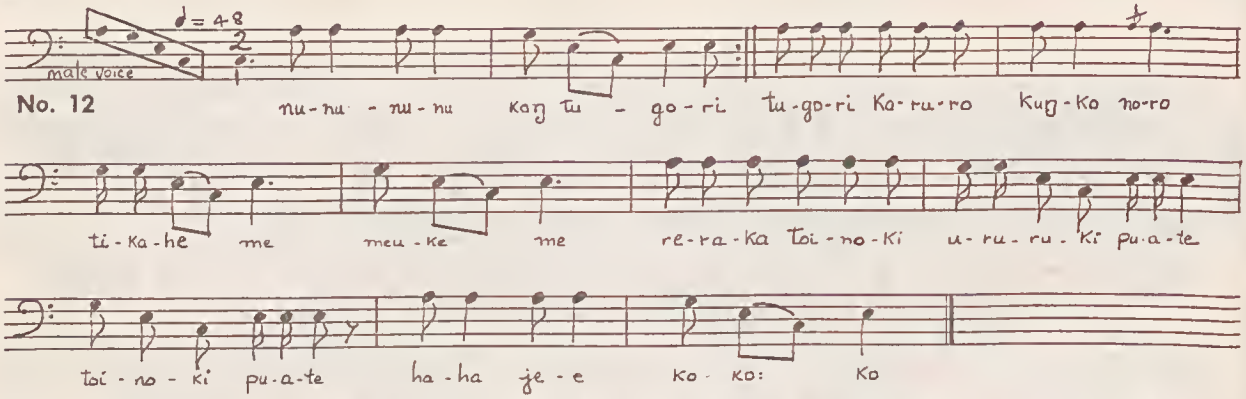
Rat Song recorded by E. H. Davies in 1927. Song text (Aranda) transcribed by T. G. H. Strehlow. (Three discs (78 RPM) "Australian Aboriginal Songs" PRX Nos. 9-11, No. 1, Item 2, Columbia Graphaphone (Aust.) for the *University of Adelaide.*). Duration: 15".

a bang a bang a bang a bang a bang a bang
gum-be-ry jah. gin-gun. ve-lah gum-be-ry jah. gin-gun velah a bang a bang a
bang a bang a bang a bang a bang a bang

No. 10

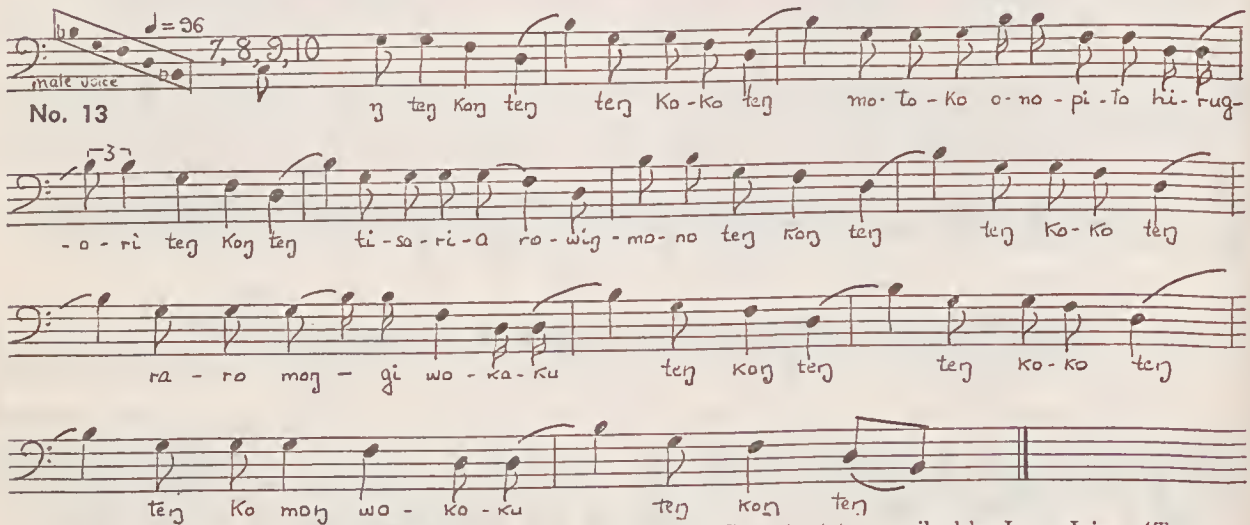
"Australian Song". Melody and song text published in 1825 by Barron Field.[15]


Bar-ra-bu-la bar-ra-ma man-gi-nè wey en-gu-na Bar-ra-bu-la
bar-ra-ma man-gi-nè wey en-gu-na Bar-ra-bu-la bar-ra-ma man-gi-nè wey en-
gu-na Bar-ra-bu-la ba-ra-ma man-gi-nè wey en-gu-na
Bar-ra-bu-la bar-ra-ma man-gi-nè wey en-gu-na

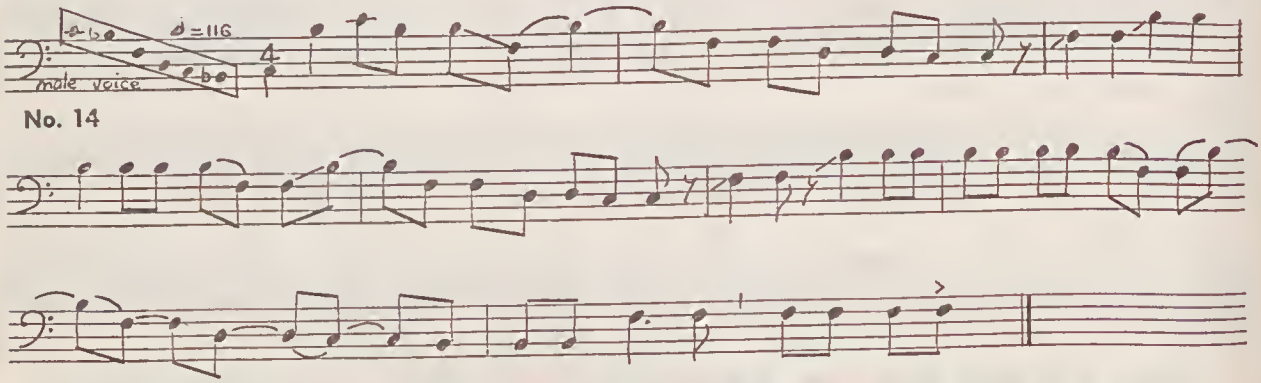
No. 11

"Song of Bennalong in England". Melody and song text published in London in 1811 by Edward Jones.[14]

♩= 48
male voice
No. 12
nu-nu - nu-nu Kaŋ tu - go-ri tu-go-ri Ka-ru-ro Kuŋ-Ko no-ro
ti-Ka-he me meu-Ke me re-ra-Ka toi-no-Ki u-ru-ru-Ki pu-a-te
toi-no-Ki pu-a-te ha-ha je-e Ko Ko: Ko

Isaac Iripu's Song, No. 1, recorded by A. J. Hall in 1960. Song text transcribed by Isaac Iripu, a student from Siwai, South Bougainville, Solomon Islands. (Tape copy, Ethnomusicology Section, Department of Music, Monash University, Victoria.). Duration: 31".


♩= 96
male voice
No. 13
ŋ teŋ Kaŋ teŋ teŋ Ko-Ko teŋ mo-to-Ko o-no-pi-To hi-ruŋ-
-o-ri teŋ Kaŋ teŋ ti-sa-ri-a ro-wiŋ-mo-no teŋ Kaŋ teŋ teŋ Ko-Ko teŋ
ra-ro moŋ-gi wo-Ka-Ku teŋ Kaŋ teŋ teŋ Ko-Ko teŋ
teŋ Ko moŋ wo-Ko-Ku teŋ Kaŋ teŋ

Isaac Iripu's Song, No. 2, recorded by A. J. Hall in 1960. Song text transcribed by Isaac Iripu. (Tape copy, Ethnomusicology Section, Department of Music, Monash University, Victoria). Duration: 35".



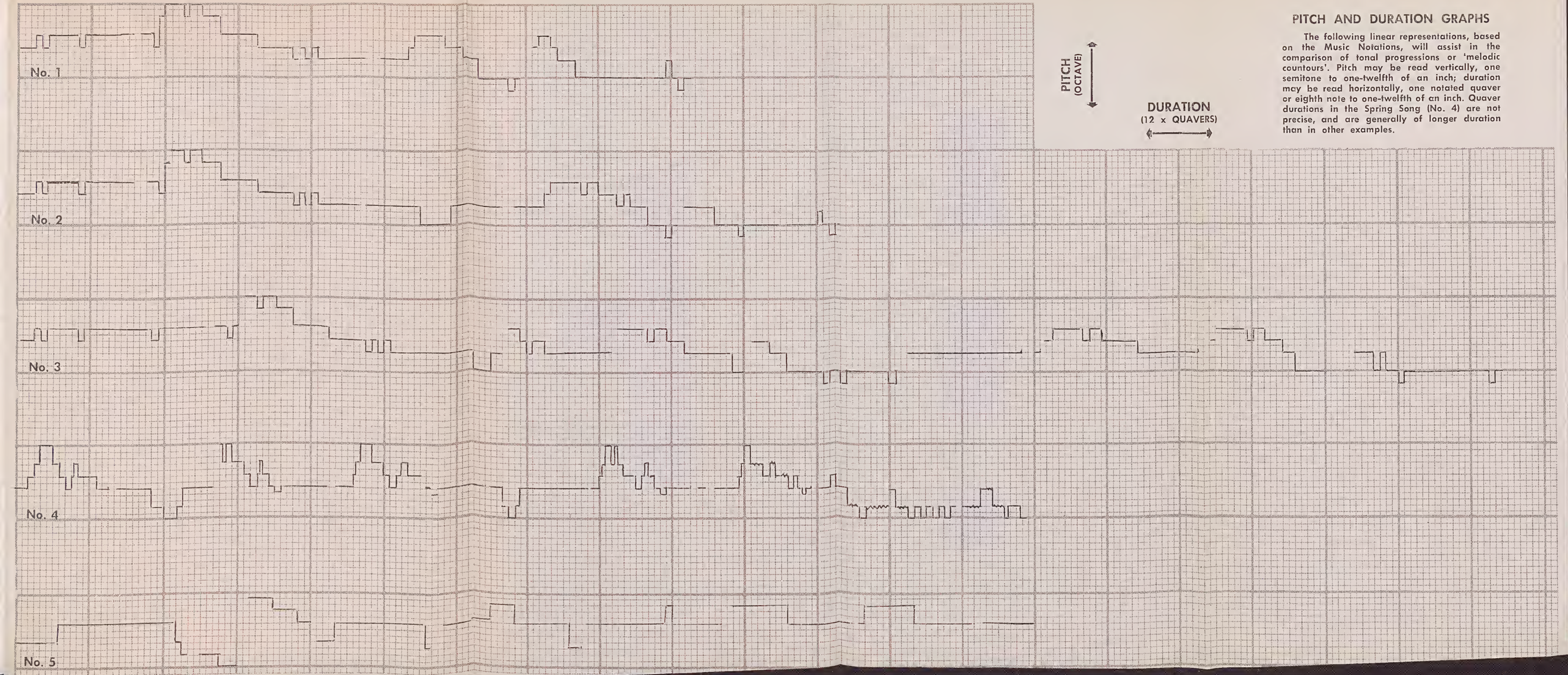
Tsegul, from Buka Island, Solomon Islands, recorded by R. Sheridan in 1958. Song text not transcribed. Disc, issued 1959, (33 1/3 RPM) "Music of New Guinea" No. 2, Side 2, Band 7a, *Wattle Archive Series.* Duration: 20".

PITCH AND DURATION GRAPHS

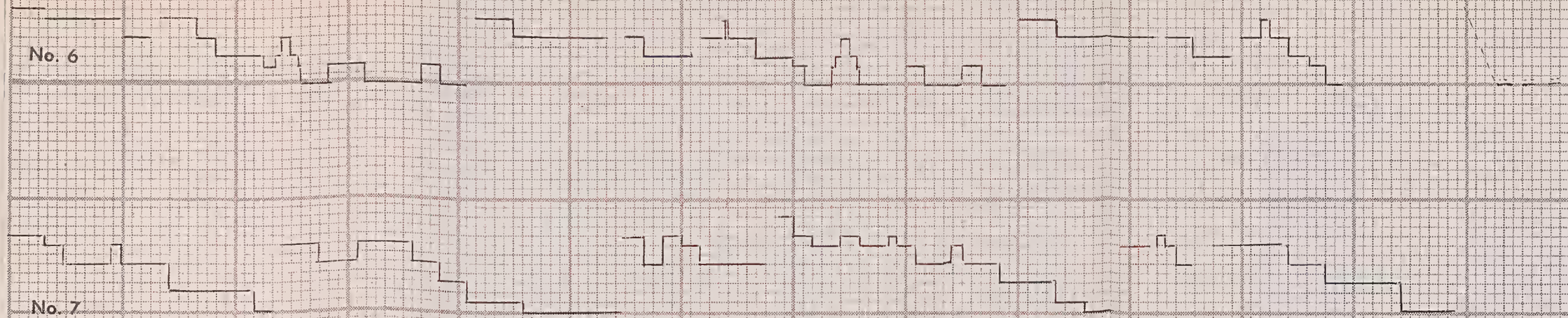
The following linear representations, based on the Music Notations, will assist in the comparison of tonal progressions or 'melodic countours'. Pitch may be read vertically, one semitone to one-twelfth of an inch; duration may be read horizontally, one notated quaver or eighth note to one-twelfth of an inch. Quaver durations in the Spring Song (No. 4) are not precise, and are generally of longer duration than in other examples.

PITCH (OCTAVE)

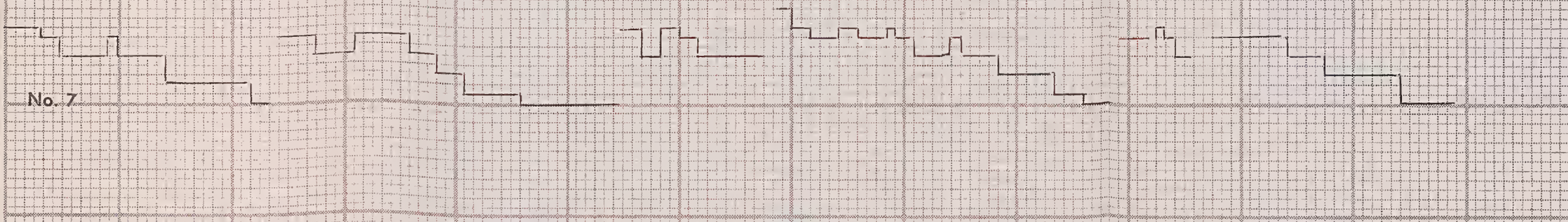
DURATION (12 x QUAVERS)



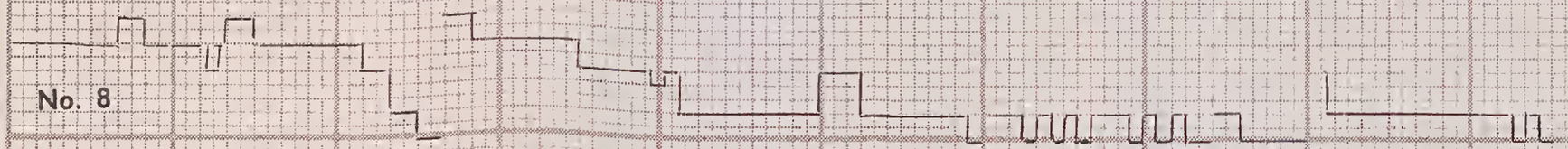
No. 6



No. 7



No. 8



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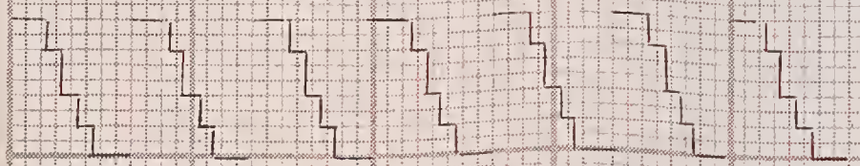

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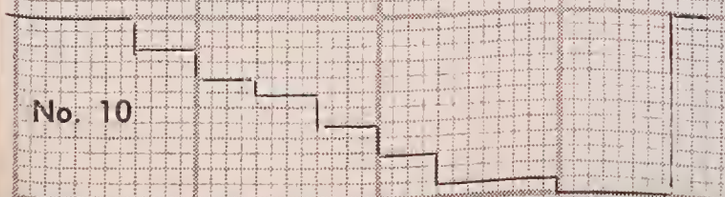
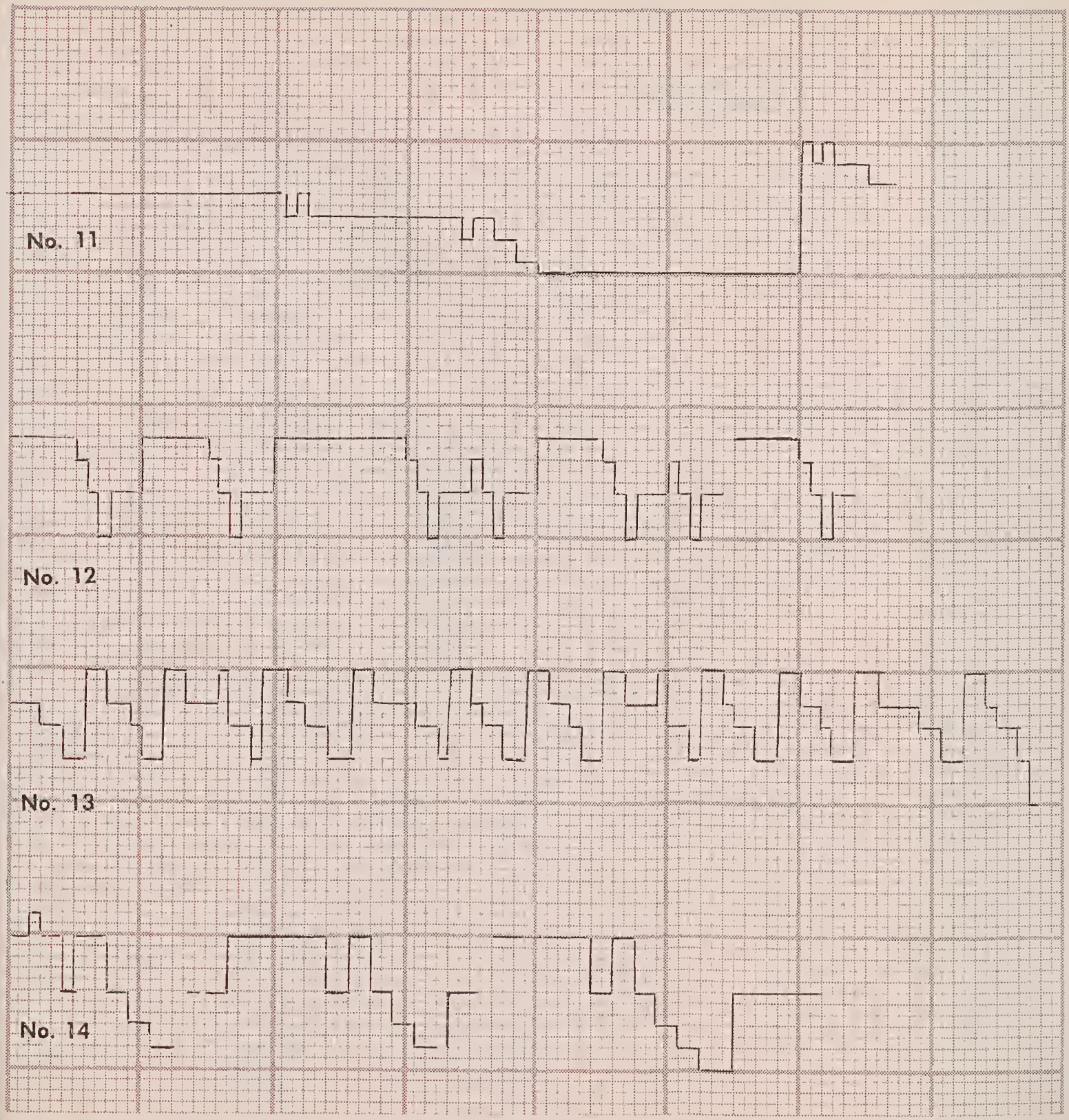
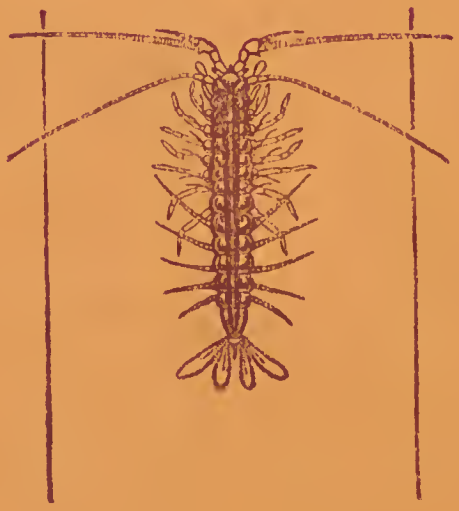



No. 11
No. 12
No. 13
No. 14

NATIONAL MUSEUM
23 JUL 1967
OF VICTORIA

No. 27

RECORDS OF THE QUEEN VICTORIA MUSEUM LAUNCESTON



Edited by
W. F. ELLIS
Director of the Museum

PUBLISHED BY THE MUSEUM COMMITTEE
LAUNCESTON CITY COUNCIL

NOTES ON THE DEVIL *(SARCOPHILUS HARRISI)* AND THE QUOLL *(DASYURUS VIVERRINUS)* IN NORTH-EASTERN TASMANIA

by
R. H. GREEN,
Queen Victoria Museum, Launceston

Manuscript received 31/12/66. *Published 10/5/67.*

SUMMARY

A series of 33 Devils (*Sarcophilus harrisi*) and 49 Quolls (*Dasyurus viverrinus*), were collected in north-eastern Tasmania in July, 1964. The topography, vegetation and associated fauna of the area from which they were taken are discussed.

Brief descriptions of the Devil and Quoll are given including notes on pelage. Weights and measurement of carcases and a series of skull measurements are tabulated and show that in both species males generally exceed the females in all proportions. A significant imbalance in favour of males occurred in the adult Quolls.

Data are given on breeding, pouch condition and development of the pouched young. Sixteen sets of pouched young Quolls are tabulated to show sex and colour phase proportions. The colour phase of Quolls is determinable from a crown-rump length of 10 mm.

Contents of the stomachs are tabulated and discussed and some effects of fighting and accidental snaring are noted.

A list of ectoparasites recorded from both species in Tasmania is given.

General comments are given on the probable effect of land development, the predatory habits of the species, and the implications that these factors may have on their future population.

I. INTRODUCTION

The Devil (*Sarcophilus harrisi*) and Quoll (*Dasyurus viverrinus*) are again becoming plentiful in Tasmania and are now being found in areas where they have not been recorded for many years.

Since the advent of white man to Tasmania both species have been drastically reduced in numbers and range. Shrinkage of range inevitably followed the spread of settlement, because of destruction of forest habitat and even the animals themselves by settlers when they preyed on domestic poultry and stock. In addition, a disease affecting the larger dasyurids is believed to have caused a sudden decline in the early part of this century (Guiler 1964) and apparently extended to areas not affected by the human population.

The numerical fluctuations of both species during the nineteenth century are difficult to trace and the few published accounts are little more than impressions. Referring to the Devil, Waterhouse (1846) quoting a Mr. Harris states, "these animals were very common on our first settling at Hobart Town and were particularly destructive to poultry etc. They, however, furnished the convicts with a fresh meal and the taste was said to be not unlike veal".

Gould (1863) states, "It has now become so scarce in all the cultivated districts, that it is rarely, if ever, seen there in a state of nature".

Smith (1909) states that the Devil was still widespread as late as 1909 but by 1918 Lord (1918) states "It is now only met with in the rugged unsettled areas". In the next few years, because of the rarity of sightings, fear was often expressed that the Devil along with the Tasmanian Tiger (*Thylacinus cynocephalus*) was facing imminent extinction but in recent years the Devil has undergone a spectacular population recovery and is today abundant over large areas of the State.

There is little published information available on the past status of the Quoll in Tasmania but from inquiries and personal knowledge it seems that its population fluctuation followed a similar pattern to that of the Devil. In most of the midlands it is still a rare animal but in the days of early settlement must have been very plentiful in this area. Backhouse (1843) having visited the property of Mr. John Bisdee in the southern midlands in February, 1834 stated : "The Common Pheasant has been introduced upon this estate, and in order to preserve it, his men have been encouraged to destroy the Native Cats, by receiving eight-pence for each of their skins. These animals are so numerous, that at one time the people brought in six hundred skins". Despite these efforts the Pheasants did not become established.

Referring to the Middlesex Plains and Cradle Mountain areas in the rugged north-western highlands, Weindorfer and Francis (1920) stated : "The light brown, white-spotted variety is fairly plentiful in the district ; the black and white extremely rare."

Both the Devil and Quoll have now reached virtual pest proportions in some pastoral areas, particularly in the north-west and north-east of the island. Because of its larger size and voracious appetite the Devil is considered a greater pest in the rural areas than the Quoll although the latter may in fact be even more prevalent.

A general account of the Devil is given by Guiler (1964) and Sharland (1962) discusses both the Devil and the Quoll.

In 1964 the opportunity was taken to collect a series of specimens from a pastoral property near Gladstone in north-eastern Tasmania. A limited permit had been issued to the owners to destroy marauding Devils which were in such numbers that they were believed to be preying on young lambs. Consequently with the co-operation of the stock manager, a quantity of the material was salvaged from the animals destroyed under his permit.

A preliminary note based on this material is given here and except where otherwise stated, is confined to this sample. An investigation of wider scope is envisaged in the future.,

II. HABITAT AND ASSOCIATED FAUNA

The sample was collected on Icena Estate, about eight miles north-east of Gladstone in the far north-east of Tasmania. (See map, fig. 1). Collecting was confined to an area of homestead paddocks totalling about a thousand acres and along two roads for a distance of about five miles from the homestead.

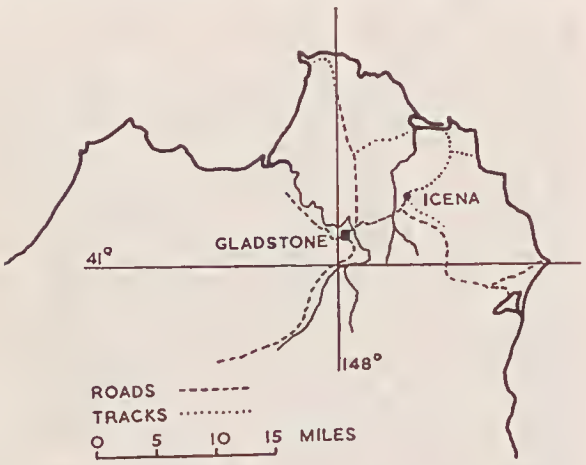


Figure 1. Sketch map of the Gladstone district in north-eastern Tasmania, showing the location of the area from which the animals were collected.

This area lies within the coastal plain but some miles further inland the topography becomes hilly rising in places to over a thousand feet. Soils are mostly yellow podzols supporting dry sclerophyll forest but the northern coastal strip supports mainly coastal heath.

The forest consists mostly of eucalypts including *Eucalyptus obliqua, E. viminalis, E. amygdalina* and *E. ovata,* with a scattering of *Casuarina quadrivalvis* (She Oak) occurring in dense clumps on banks. *Banksia marginata* (Honeysuckle) is also quite common. An under storey of *Melaleuca cricifolia* (Swamp Tea-tree) and *M. squarrosa* (Bottle Brush), occurs in thick clumps throughout the forest areas ; while along the water courses *Leptospermum lanigerum* (Woolly Tea-tree) and *Hakea nodosa* (Nut Bush) grow densely. The ground cover includes *Pteridium esculentum* (Bracken Fern), *Diplarrhena moraea* (Sagg), *Xerotes longifolia* (Sagg), *Epacridaceae* spp. (Heaths), *Ricinocarpus pinifolious* (Wedding Bush), *Hibbertia procumbens* (Guinea Flower) and *Baeckea ramosissima.*

In open areas *Casuarina distyla* (Ground Oak), *Melaleuca gibbosa* (Tea-tree) and *Leptospermum scoparium* (Tea-tree) often form a dense ground cover growing to about two feet.

Gymnoschoenus sphaerocephalus (Button Grass) also occurs in fairly extensive belts as openings in the forest.

The principal coastal vegetation includes *Eucalyptus* spp., *Acacia sophorae* (Boobyalla), *Bursaria spinosa* (Prickly Box) and *Leucopogon virgatus* (White Currant) with a ground cover of *Epacridaceae* spp. (Heaths), *Ricinocarpus pinifolious* (Wedding Bush) and *Xerotes longifolia* (Sagg).

Sheep and cattle are grazed throughout the whole area and much of the suitable land is now being cleared, ploughed and developed into improved grasslands.

Annual rainfall averages about 30 inches, being slightly less on the coast and slightly more on the higher inland areas.

Mean summer temperature (January) is about 62°F. and mean winter temperature (July) about 48°F., with extremes from 95°F. to 25°F.

The area in its natural form provided a favourable environment for most of the mammal and bird species recorded from Tasmania (see tables 1 and 2) and although land development is removing natural habitat, it is providing an enhanced food supply for some species. However, when predation by native animals becomes excessive, population control becomes a necessary part of good pasture and stock management.

Three large macropods (see table 1) occur in sufficient numbers to cause significant pasture damage by grazing on areas where pasture improvement is taking place and both snaring and shooting are continuously employed to keep both wallaby species in check. The Forester Kangaroo is afforded total protection because of its limited distribution.

Examination of stomach contents of Devils and Quolls suggests that their status may well be influenced by the present macropod population. However, the partly insectivorous diet and partly arboreal habits of the Quoll make this animal a more generalised feeder and probably less dependent on scavenged foods so efficiently used by the Devil.

Both species co-exist in similar habitat and may be trapped side by side. However, the Devil is cannibalistic and will readily eat the dead of its own kind. Batey (1907) refers to cannibalism in the Quoll.

They appear to have few natural enemies but station dogs left unchained at night take a toll of Devils and Quolls which venture too close to homesteads.

III. METHODS AND MATERIALS

(i) Collecting

Most of the animals were taken in steel rabbit traps set on the ground and tied to a fence or tree. A meat bait (Wallaby, Devil or Quoll) was suspended about three feet above the open trap and the animals became caught by the feet in their efforts to secure the bait. Devils were killed by shooting through the heart with a .22 rifle and Quolls were killed by breaking the neck in the same manner as killing a rabbit. Traps were cleared at first light each morning and the catch transported back to the base camp for processing.

A few poison bait stations were used by applying strychnine to a Wallaby carcase. Though Devils took the bait well, none were salvaged as they apparently travelled some distance before dying. One Devil head was found several hundred yards from the bait station, the rest of its carcase having apparently been eaten by its own kind. A number of Quolls were poisoned on bait stations, usually in pairs, and were found within 50 yards of the station.

Five Quolls were collected by shooting at night with the aid of a spot light.

TABLE 1. Mammal species (excluding domesticated stock) occurring in Tasmania with an indication of their numerical status on the Icena Estate.

SPECIES	NUMERICAL STATUS
Forester Kangaroo *Macropus giganteus*	Plentiful
Bennetts Wallaby *Wallabia rufogrisea*	Very plentiful
Pademelon *Thylogale billardieri*	Very plentiful
Bettong *Bettongia cuniculus*	Uncommon
Potoroo *Potorous tridactylus*	Uncommon
Brush Possum *Trichosurus vulpecula*	Very plentiful
Ringtail Possum *Pseudocheirus convolutor*	Present
Flying Possum *Petaurus breviceps*	Uncommon
Pigmy Possum *Cercartetus nanus*	Uncommon
Lesser Pigmy Possum *Eudromicea lepida*	Rarely found
Wombat *Vombatus ursinus*	Plentiful
Brown Bandicoot *Isoodon obesulus*	Uncommon
Striped Bandicoot *Perameles gunnii*	Uncommon
Tasmanian Tiger *Thylacinus cyanocephalus*	Not positively recorded for many years.
Devil *Sarcophilus harrisi*	Very plentiful
Tiger Cat *Dasyurops maculatus*	Rare
Quoll *Dasyurus viverrinus*	Very plentiful
Spiny Anteater *Tachyglossus sctosus*	Plentiful
Platypus *Ornithorhynchus anatinus*	Plentiful
Water Rat *Hydromys chrysogaster*	Plentiful near the coast and rivers
Rats (Species unknown)	Present but more plentiful some years ago
European House Mouse *Mus musculus*	Plentiful at times
Rabbit *Oryctolagus cuniculus*	Present in limited numbers
Ferral Cat *Felis domesticus*	Not commonly seen

TABLE 2. Bird species (excluding domesticated stock) recorded in the Icena Estate area with an indication of their numerical status. Possible role in the ecology of the Devil and Quoll given in brackets.

SPECIES		STATUS
Little Penguin *Eudyptula minor*	(Food)	A few at times along the coast
Quail species	(Food)	Present
Bronzewing species	(Food)	Not plentiful
Lewins Water-rail *Rallus pectoralis*	(Food)	A few about the rivers
Native Hen *Tribonyx mortierii*	(Food)	Plentiful in parts
Bald Coot *Porphyrio melanotus*	(Food)	A few in parts
Coot *Fulica atra*	(Food)	Common in the sheltered bays
Pied Oystercatcher *Haematopus ostralegus*	(Food)	Common on coastal beaches
Sooty Oystercatcher *Haematopus unicolor*	(Food)	Common on the coast
Spurwing Plover *Lobibyx novae-hollandiae*	(Food)	Plentiful
Banded Plover *Zonifer tricolor*	(Food)	Rarely recorded
Hooded Dotterel *Charadrius cucullatus*	(Food)	A few on coastal beaches
Double-banded Dotterel *Charadrius bicinctus*	(Food)	Common in winter on coastal beaches
Red-Capped Dotterel *Charadrius alexandrinus*	(Food)	Common on coastal beaches
Snipe *Gallinago hardwickii*	(Food)	A few in summer
White-faced Heron *Notophoyx novae-hollandiae*	(Food)	A few present
Brown Bittern *Botaurus poiciloptilus*	(Food)	A few present
Black Swan *Cygnus atratus*	(Food)	Plentiful on coastal bays and lagoons; breeding in wet years
Duck species	(Food)	Plentiful on coastal bays and lagoons
Swamp Harrier *Circus approximans*	(Food/Predator)	Common
Wedge-tailed Eagle *Aquila audax*	(Predator)	Several pairs live and breed in the area
Sea Eagle *Haliaeetus leucogaster*	(Predator)	Several pairs breed in the coastal area
Brown Hawk *Falco berigora*	(Food)	Common
Owl Species	(Food/Predator)	A few present
Lorikeets or Parakeets	(Food)	Plentiful
Black Cockatoo *Calyptorhynchus funereus*	(Food)	A few present
Green Rosella *Platycercus caledonicus*	(Food)	Plentiful
Ground Parrot *Pezoporus wallicus*	(Food)	A few in coastal heath land
Frogmouth *Podargus strigoides*	(Food)	A few present
Kookaburra *Dacelo gigas*	(Food)	Liberated in the area about 1920, now common
Quail-thrush *Cinclosoma punctatum*	(Food)	Rare
Australian Pipit *Anthus australis*	(Food)	Common
Australian Raven *Corvus* sp.	(Food)	Plentiful
Clinking Currawong *Strepera arguta*	(Food)	Common
White-backed Magpie *Gymnorhina hypoleuca*	(Food)	A few prior to 1950 but now appears absent
Blackbird *Turdus merula*	(Food)	Common
Sparrow *Passer domesticus*	(Food)	Plentiful
Goldfinch *Carduelis carduelis*	(Food)	Common
Starling *Sturnus vulgaris*	(Food)	Plentiful

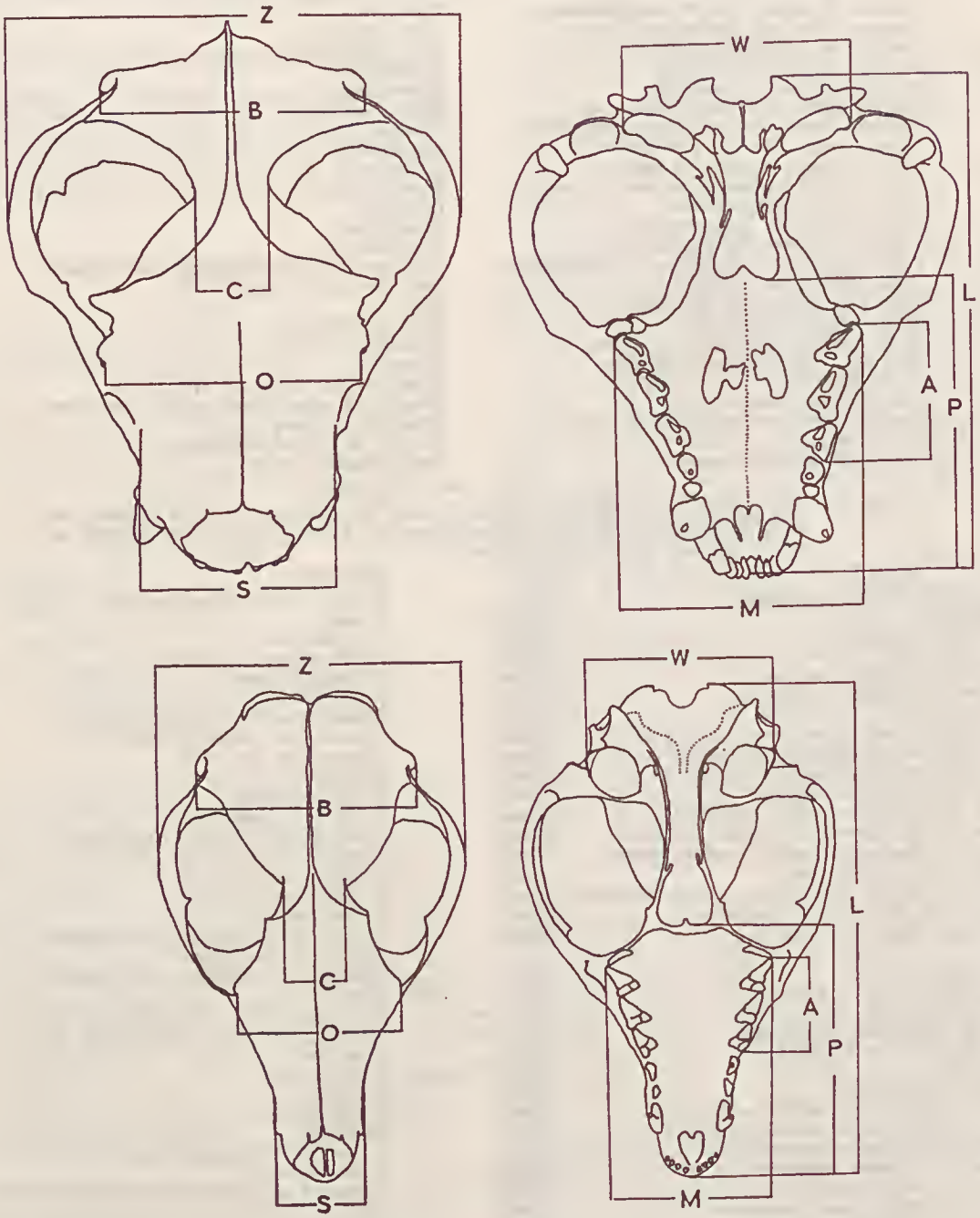


Figure 2. Points from which the skull measurements were taken. Upper, Devil; Lower, Quoll.

Ectoparasites were collected from a large sample of Devils and Quolls. The freshly collected animals were placed in large plastic bags together with a few drops of chloroform and left till the parasites had been killed. Parasites were then shaken or brushed from the fur on to a large sheet of paper and preserved in 70% alcohol. Ticks and subcutaneous flea larvae were removed with small forceps.

After skinning, the carcases were opened and visible endoparasites collected and preserved in 70% alcohol. Lungs were removed and preserved in 4% formalin. Most stomachs were examined and the contents recorded. Testes were measured, length by width. Fat condition was recorded together with any general comments.

Heads were removed, boiled and the skulls cleaned and air dried.

Over a ten day period from 20:VII:1964 to 30:VII:1964 a total of 33 Devils (19♂♂ and 14♀♀) and 49 Quolls (36♂♂ and 13♀♀) were collected and processed in this manner. The imbalance between sexes is not sufficient in the Devil to be statistically significant. That between male and female Quoll certainly is but at this stage of the investigation no explanation is offered. Two Devils and 12 Quolls were found to be carrying pouched young. In each instance, the mammary glands together with the surrounding pouch skin were removed and preserved with the pouched young in 70% alcohol.

All lung material was handed to the Mt. Pleasant Laboratories, Department of Agriculture, Launceston, for examination for the occurrence of cysts of *Emmonsia crescens*, a growth occurring in the lungs of northern hemisphere ground dwelling mammals, but not yet recorded as occurring in Australia. All results for both species were negative (Munday 1966). The brains of 3 Devils and 7 Quolls were likewise sent to the above Department for inclusion in a survey of Toxoplasmosis in native mammals. Results were again negative for both species (Munday 1966).

Parasitic material has been passed on to Mr. J. H. Calaby, Division of Wildlife Research, C.S.I.R.O., Canberra, for determination and preservation.

The skins, dried flat and unfilled, together with associated skulls and pouched young have been lodged in the collections of the Queen Victoria Museum and registered within the series 1964:1:124 to 1964:1:242.

(ii) Measurement techniques

(a) Bodies. Devils were weighed on a balance scale with a clock face graduated in pounds and ounces, and Quolls were weighed on a tray-top balance scale with metric graduations.

Both species were measured in the flesh for :

Total length : From the nose tip to the tail tip excluding terminal hair, the measurement being taken dorsally with the animal lying on its back.

Tail length : From the base of the tail to the tail tip excluding terminal hair, the measurement taken dorsally with the tail turned up at a right angle to the back.

Ear : From the outer edge of the tragoid notch to the tip of the ear, excluding the hair.

Pes : From the back of the heel to the end of the longest toe excluding the claw.

Scrotum : Measured laterally and anterior posteriorly.

(b) Skulls. The following measurements were taken as illustrated in Figure 2:

Condylo-basal length (L)
Zygomatic width (Z)
Post orbital constriction (C)
Cranium width (B)
Pre optical width (O)
Snout width (S)
Palatal Length (P)
Mastoidal width (W)
Alveola length (A)
Width at M^3 (M)

Measurements recorded by the use of callipers were made to the nearest millimeter on the Devil skulls and to the nearest tenth of a millimetre on the Quoll skulls.

IV. SARCOPHILUS HARRISI

(i) General Description

The Tasmanian Devil (Plates 1, 2) is a stout thick-set animal. A full-grown male may stand to about twelve inches at the shoulders and have a head and body length of two feet with a tail a foot long. It may attain a body weight of up to 26 pounds. The head and neck are broad and powerfully built and the jaws are very strong. It is rather slow and clumsy in its movements and appears to possess a powerful sense of smell, as it noses the ground almost continuously in its slow meandering gait. Its general disposition appears savage and disagreeable and it will readily growl and show its powerful teeth when disturbed. Though its bite is capable of inflicting a severe wound, its lack of swift aggressive movements renders it less dangerous than its appearance suggests. Captive animals under the care of a good keeper have been known to become quite docile and easily handled.

(ii) Body Weight and Size

In average weight and size males exceeded females by a significant margin, and were generally of a more robust appearance (see table 3).

The tail, ear and pes length, expressed as a percentage of the total length (see table 4), gives some idea of the body proportions of the sex groups but shows very little sexual dimorphism.

(iii) Skull

The skull measurements shown in table 5 also indicate the greater mean size of males. When the mean values are expressed as a percentage of the condylo-basal length (see table 6) they show the skulls of males to be relatively broader than those of females and with a significantly narrower post orbital constriction. This was also found to be the case in the Quolls.

The sagital crest is noticeably higher in the larger and apparently older animals.

Tooth wear is present on all teeth and in some instances the molar cusps have been worn down to the body of the tooth. The tips of incisors, canines and premolars exhibit wear to a similar degree.

Tooth fracturing is common and in older animals may be extensive with any teeth being affected. Some molars were found broken off at gum level and others split with the two halves remaining in place. Several canines were found to have broken tips and the closely set incisors were badly fractured in a number of instances.

The only deviation from the normal dental complement of I. 4/4, C. 1/1, P.M. 2/2, M. 4/4 was the occurrence in four skulls (Reg. No. 1964:1:124♂ ; 134♀ ; 186♂ ; 201♂) of a fifth upper right molar. (See plate 3). In each instance these were found internally adjacent to and about half the size of M^4. They all exhibited wear to a degree similar to the associated teeth and the crown level was lower than that of M^4.

There was no indication of decay in the teeth of any Devils.

TABLE 3. Comparative body measurements of males and females of the Devils, showing the range, mean in brackets and standard deviation respectively. Weight in pounds, lengths in millimetres.

	Males (19)			Females (14)		
Weight	12 - 26	(18.2)	4.38	9 - 18	(12.2)	2.42
Total length	740 - 910	(844.6)	49.22	750 - 840	(776.7)	28.91
Tail length	235 - 285	(258.9)	14.68	215 - 270	(244.6)	15.87
Ear length	63 - 80	(70.2)	5.92	58 - 73	(63.3)	4.88
Pes length	85 - 96	(91.0)	3.12	77 - 85	(83.7)	2.74

TABLE 4. Showing length of tail, ear and pes expressed as a percentage of the total length of males and females of the Devils.

	Males	Females
Tail length	30.6	31.5
Ear length	8.3	8.1
Pes length	10.8	10.8

TABLE 5. Comparative skull measurements of males and females of the Devils. The mean is shown in brackets.

	Males		Females	
Condylo-basal length	117 - 140	(131.6)	116 - 132	(122.3)
Zygomatic width	97 - 126	(112.2)	95 - 111	(100.7)
Post orbital constriction	18.5 - 20.5	(19.5)	19 - 21	(20.4)
Cranium width	62 - 77	(70.8)	59 - 67	(63.5)
Pre optical width	50 - 60	(55.4)	49 - 54	(51.2)
Snout width	35 - 43	(39.0)	33 - 39	(35.7)
Palatal length	71 - 81	(76.3)	69 - 78	(72.0)
Mastoidal width	57 - 68	(63.2)	56 - 60	(58.7)
Alveola length	34 - 36	(35.0)	33 - 36	(34.5)
Width at M^3	62 - 67	(63.8)	57 - 63	(61.0)

TABLE 6. Showing the Devil skull measurements expressed as a percentage of the condylo-basal length.

	Males	Females
Zygomatic width	85.3	82.3
Post orbital constriction	14.8	16.7
Cranium width	53.8	51.9
Pre optical width	42.1	41.9
Snout width	29.6	29.2
Palatal length	58.0	58.9
Mastoidal width	48.0	48.0
Alveola length	28.1	28.2
Width at M^3	48.5	49.8

(iv) Pelage

An examination of the Icena series reveals the under fur to be dark brown, being darkest on the shoulders and mid dorsal region. The outer fur is a uniform black. This produces a superficially black appearance but in the older specimens with less dense fur a brownish shade becomes noticable. The body fur reaches to 20 mm. and the guard hairs to 35 mm. In most Devils the fur appears densest on the hind quarters, but in the case of several aged individuals the densest region is on the shoulders.

Hair on the toes of the front feet is short and does not cover the claws. On the toes of the hind feet it extends beyond the claws, in most instances completely covering them. The claws of the front feet exhibit more wear than do those of the hind feet, reflecting greater use.

Hair on the distal half of the tail is long and in extreme examples reaches to 80 mm. In most animals this hair and that in the region of the pouch or scrotum shows a reddish-brown shading.

The vibrissae are black and vary considerably in length and thickness. The mystacial reach to 140 mm. with up to 34 in each set, genal to 130 mm. with up to 15 a set, supraorbital to 78 mm. with up to 7 a set and interramal to 60 mm. with up to 7 a set.

Most Devils possess minor white markings and though this varies in extent between individuals the positioning is constant. These white markings occur in two regions only.

(1) As a rump spot situated just forward of the base of the tail.

(2) As a neck and shoulder blaze extending in a crescent from beneath the base of the neck onto the anterior scapular region.

The rump spot may be up to 40 mm. across. The neck-shoulder blaze may be continuous, broken or merely occur as an odd isolated marking on the neck or shoulders.

Of the 33 Devils examined, 19 possessed both markings in varying extent, 7 possessed only the neck-shoulder blaze or part thereof, 2 possessed only the rump spot, in both instances very small, and 5 had no markings.

(v) Breeding

Of the 14 females collected, 12 had empty pouches with no obvious signs of lactation.

In the non-lactating females the pouch opening of dead animals, measured when in its normal relaxed state, ranged from 30 mm. to 45 mm. across. In depth, forward of the anterior edge of the pouch opening, it ranged from 10 mm. to 50 mm.

The normal nipple complement was 4 with little difference in the size range, the length being about 4 mm. There was no indication that suckling continues once the young become independent of the pouch. One female, (Reg. No. 1964:1:178) possessed a fifth nipple on the right side and posterior to the four normally positioned nipples. It was much smaller than the others and was probably non-functional. Coarse reddish-brown hair was growing from the inside edge of the pouches. It varied in density and length between individuals but in some cases was quite prominent and reached a length of 100 mm.

Reg. No. 1964:1:151, a female trapped on 24:VII:1964 and of 13.5 lbs. body weight, carried 3 pouched young (2♀♀ and 1♂) of an approximate total length of 160 mm. (see plate 4). The anterior right nipple was vacant, partly inverted and reaching to 7 mm. in a normal retracted position. The remaining 3 occupied nipples ranged from 25 mm. to 30 mm. in length and were partly flattened to 7 mm. presumably by the sucking action of the young. The terminal two thirds of the occupied nipples were held within the mouth of the young. Little effort was required to remove them. The normal pouch opening was 70 mm. and the depth was 80 mm. Reddish-brown hairs growing from the inner edge of the pouch reached to 80 mm.

The mouths of the young were not open more than necessary to accommodate the nipple and none of the teeth had erupted. Body fur was sparse and reached to 2 mm. but was more prominent on the head and dorsal thoracic region. Vibrissae were black with the mystacial reaching to 22 mm., genal to 22 mm., supraorbital to 18 mm., and interramal to 16 mm.

The eyes and ears appeared to have recently opened. The claws on the front and hind feet were stout, reaching to 3 mm. in length. The head was proportionally large and about 70% of the body length. One female was slightly less developed than her two pouch mates.

Reg. No. 1964:1:203, a female trapped on 29:VII:1964 and body weight of 12 lbs., carried one pouched young attached to the posterior right nipple. The 3 unoccupied nipples were 3 mm. long and their associated milk glands showed no signs of lactation. The occupied nipple and young were, for all practical purposes, similar to those of 1964:1:151. The pouch opening was 50 mm. and depth 60 mm. with pouch hair to 80 mm.

Reg. No. 1964:1:158, a single female pouched young, was found on 24:VII:1964 when it had apparently been cast from its mother's pouch when she became caught in a necker snare set for wallabies. The mother had subsequently escaped by chewing through the wire snare and had abandoned the young. It was alive when found and had a body weight of 190 gm. and a total length of 230 mm.

The fur was longest on the head and neck where it reached to 10 mm. The vibrissae were black with the mystacial reaching to 31 mm., the genal to 33 mm., supraorbital to 25 mm., and interramal to 18 mm. The head was proportionally large being about 70% of the body length. Eyes, ears and mouth were fully open. One pair of incisor teeth in the upper jaw and one pair of incisors in the lower jaw were just starting to erupt.

Guiler (1964) states that Devils breed in March and that the young have presumably all left their mother's pouch by late October. Though the material in the present series supports this conclusion, the Queen Victoria Museum collection contains 2 sets of pouched young collected from the Icena area in 1963 which probably would not have become independent until November. 1963:1:268 collected during September includes 4 pouched young in which the fur had only just begun to erupt on the head and neck. 1963:1:269 collected during October includes 2 pouched young firmly attached to the nipples and only slightly more advanced than those described under Reg. No. 1964:1:151.

The testes of the males collected in the present Icena series ranged from 15 x 11 mm. to 20 x 17 mm., the heavier animals usually having the larger testes.

(vi) Stomach Contents

Most of the stomachs were opened immediately after skinning and the contents found to be poorly masticated. In many instances the Devils were found to have been feeding on Wallabies (*Wallibia rufogrisea*) as the fur of this animal was identifiable in nine stomachs (see table 7). Wallaby snaring was being carried out in the

TABLE 7. An analysis of the stomach contents of 30 Devils collected at Icena in July, 1964.

Materials found in stomachs	Instances of occurrences
Unidentified flesh	6
Wallaby (probably *W. rufogrisea*) gut	1
Devil (*S. harrisi*) fur	2
Wallaby (*W. rufogrisea*) fur	9
Brush Possum (*T. vulpecula*) fur	1
Unidentified fur	10
Wool	3
Unidentified feathers	1
Crushed bone	1
Vegetable matter (grass, bark)	7
Gravel	1
Excess water-like fluid	1

vicinity by a professional snarer and the Devils were apparently feeding on snared animals. It is usual for a number of Devils to feed on one carcase and in many instances a whole Wallaby, which may weigh up to 40 lbs., would be eaten over night. This performance might be repeated several times in every mile of the snare line. The only evidence of the catch would be a sprung snare, trampled vegetation and perhaps and odd Wallaby tooth and a little fur.

Most of the unidentifiable fur (see table 7) was probably that of *W. rufogrisea*.

The occurrence of wool in 3 stomachs was considered normal. Sheep graze throughout the area and as some deaths are inevitable from various causes it is natural that some wool would be ingested in the course of Devils scavenging on sheep carcases.

Most of the vegetable matter and gravel was probably taken while the animals were in the traps. In their endeavours to escape Devils will chew at anything within reach, and, as a result, their teeth and mouths were often found to be heavily soiled with dirt and litter.

The occurrence of Devil fur in two instances is further evidence of their cannibalistic habits. In January 1966, I was given a live half grown Devil which had just been trapped near Kelso at the mouth of the Tamar River. At the time of release the foot by which it had been caught appeared to be undamaged. When I inspected the animal several hours later three toes and half the manus were missing from the trapped foot. Upon later examination of the stomach contents the missing members were found in an undigested state, apparently having been chewed off and swallowed by the Devil in an attempt to relieve the pain. The stomach contents of this animal also included remains of marine crabs and fish scales.

Guiler (1960; 1964) lists many additional food items including snakes, all of which are venomous species in Tasmania. B. C. Mollison (pers. comm.) also records reptiles as food items of Devils but it is not known whether they are taken alive or scavenged after having died from other causes.

Mollison (1961) records mortality from poisoned baits of a bran-pollard mix.

(vii) General Comments

Many of the older Devils were heavily scarred about the head, apparently as a result of fighting. In some instances deep wounds were suppurating freely. Lesions on the nose and lips were common and in extreme cases caused distortion of features.

Most of the Devils collected were found to have been previously snared by the neck in Wallaby snares. Snares are made of several strands of fine pliable wire rolled together and are normally set along a fence on well worn Wallaby runs. In the Icena area these runs are very numerous and along most fence lines in bush country they may be as frequent as 5 or 6 in every 100 yards.

Devils follow these runs regularly and though they repeatedly become snared they soon chew through the wire strands of the lead, thus escaping with the tight fitting wire loop still fastened round the neck. The professional snarer operating in the area informed me that he had seen Devils carrying as many as three snares.

Though some are able to remove the snare later, others do not or cannot, with the result that it aggravates the skin and in extreme cases causes a deep suppurating wound round the neck. Several Devils were found in this condition and others carried snares which had caused injuries of a lesser degree. Most Devils possessed neck wounds or lesions in evidence that they had at some time been snared.

No signs of sickness or disease were evident.

Ectoparasites were collected from a range of Devils and have been deposited in the National Insect Collection, Canberra. Determinations, available at the time of writing, from this series and other samples collected by B. C. Mollison and T. O. Wolf are listed in table 8.

TABLE 8. Ectoparasites collected from Devils.

ACARINA

Ticks (determined by Dr. F. H. S. Roberts)

Ixodes tasmani. Hilltop, (♀) 24.II.1961 ; Maydena, (♀♀) 11.V.1961, 2.II.1962; Rocherlea, (♀♀ & larvae) 11.II.1962; Florentine Valley, (♀♀) 22-29.VII.1964.

I. fecialis. Maydena, (♀♀) 2.II.1962 ; Icena, (♀♀) 22-29.VII.1964.

INSECTA

Fleas (determined by Dr. G. M. Dunnet)

Uropsylla tasmanicus. Icena, 22-29.VII.1964.

Plate 1. A male Tasmanian Devil. (Photo by courtesy of Mr. Lionel Jensen).

Plate 2. A male Tasmanian Devil in a defensive threat posture.
(Photo by courtesy of Mr. Lionel Jensen).

Plate 3. Skull and mandible of *S. harrisi* (Reg. No. 1964:1:191). The abnormal tooth is shown inset.

Plate 4. Tasmanian Devil (Reg. No. 1964:1:151) with three young partly removed from the pouch.

Plate 5. The carcase of a freshly killed Devil showing heavy fat deposits.

Plate 6. A male Quoll.

Plate 7. Skull and mandible of *D. viverrinus* (Reg. No. 1964:1:154).

Plate 8. The pouch of a Quoll opened to expose the six pouched young.

The general condition of the animals was very good and most carried heavy fat deposits. This was more pronounced in the older animals and it was usual for them to have a subcutaneous fat layer up to half an inch in thickness and visceral deposits which completely covered the intestines and kidneys (see plate 5).

It appears probable that the high Devil population encountered at the present time is being supported by a readily available food supply far in excess of pre-settlement days. Wallabies and Possums are very numerous in the area and the commercial snaring of these animals provide an easy catch for the nocturnal Devil. The expansion of the grazing industry is also providing an additional and increasing food source in the form of natural stock deaths. Though this development is removing forever some of the habitat essential for the survival of the species, there is much which appears too rough for improvement and will probably remain in its present state for many years.

Devils will hide by day in any available cover such as Wombat holes, hollow logs, beneath buildings or in dense bush, and the undeveloped bushland provides the best areas for such diurnal retreats. At dusk they venture out on their nocturnal prowl and are capable of travelling several miles from their lairs in search of food.

It is doubtful if they will kill grown sheep in a normal healthy condition but they quickly recognize the sick or dying animal as an easy kill; consequently weak or motherless lambs provide an easy prey. Tethered or closely penned sheep are always liable to nocturnal attack and a sheep dog pup belonging to an employee of Icena estate was killed and completely eaten while on its chain.

Such instances of predation on domestic stock naturally incite the primary producer to exercise some measure of control. As a result, no doubt, some Devils are killed illegally but a number of permits have been issued in recent years for their destruction in limited areas when the circumstances demanded.

It is difficult to assess whether land clearing and development will eventually have an adverse affect on the well-being of the Devil but it is today probably more numerous in some districts than ever before. Provided it remains free from epidemic diseases or other limiting factors acting at a critical level, I see no reason why it should not continue to flourish indefinitely in many parts of the State.

V. DASYURUS VIVERRINUS

(i) General Description

The Quoll (see plate 6) is a sleek, short legged and active animal. Full grown individuals rarely stand above 6 inches at the shoulders though they may attain a head and body length of up to 18 inches and a tail to 11 inches. Mature males may weigh up to 1400 gm.

The head and neck are stout and the jaws are comparatively large and powerful. The canine teeth are long and slender, the muzzle elongated and pointed. When at large it is always alert ; its movements are stealthy and when the need demands it can move with great swiftness. In the wild state it has an inquisitive nature and will enter huts and bushmen's camps in search of food. It is easily approached with the use of a spot light and Weindorfer and Francis (1920) found it apparently oblivious of danger from dogs when its attention was held by the beam of a lamp.

In captivity it is shy and nervous but inoffensive unless provoked. Its bite is capable of inflicting a severe wound but with care wild caught animals can be tamed and handled. When agitated or frightened it will sometimes utter gutteral sounds described by Weindorfer and Francis (1920) as "not unlike those produced by the cracking of nuts in quick succession".

(ii) Body Weight and Size

In average weight and size males exceeded females by a significant margin (see table 9). The tail, ear and pes, expressed as a percentage of the total length (see table 10), gives some idea of the body proportions of both sex groups but shows very little sexual dimorphism.

TABLE 9. Comparative body measurements of males and females of the Quolls, showing the range with mean in brackets. Weight in grams length in millimetres.

	Males (36)	Females (13)
Weight	850 - 1550 (1131.6)	600 - 1030 (818.4)
Total length	525 - 655 (568.8)	475 - 580 (535.2)
Tail length	200 - 280 (240.9)	173 - 240 (220.8)
Ear length	49 - 57 (52.0)	46 - 51 (49.5)
Pes length	61 - 75 (69.4)	60 - 68 (64.1)

TABLE 10. Showing length of tail, ear and pes expressed as a percentage of the total length of males and females of the Quolls.

	Males	Females
Tail length	42.35	41.25
Ear length	9.1	9.3
Pes length	12.2	11.9

TABLE 11. Comparative skull measurements of males and females of the Quolls. The mean is shown in brackets.

	Males		Females	
Condylo-basal length	73.0 - 90.0	(81.9)	69.6 - 78.5	(74.1)
Zygomatic width	42.7 - 52.8	(47.1)	39.4 - 46.0	(42.0)
Post orbital constriction	11.0 - 13.2	(12.2)	11.8 - 13.5	(12.5)
Cranium width	26.5 - 33.3	(30.7)	26.6 - 29.5	(28.0)
Pre optical width	24.0 - 29.0	(26.3)	23.0 - 25.0	(24.0)
Snout width	15.4 - 18.6	(16.9)	14.3 - 15.8	(15.1)
Palatal length	41.2 - 50.0	(46.2)	41.0 - 44.1	(42.1)
Mastoidal width	27.4 - 35.0	(31.1)	27.6 - 30.2	(28.7)
Alveola length	15.5 - 17.0	(16.3)	15.0 - 16.3	(15.6)
Width at M^3	25.5 - 29.6	(27.5)	24.3 - 27.3	(25.6)

TABLE 12. Showing the Quoll skull measurements expressed as a percentage of the condylo-basal length.

	Males	Females
Zygomatic width	57.5	56.5
Post orbital constriction	14.9	16.9
Cranium width	37.5	37.8
Pre optical width	32.1	32.4
Snout width	20.6	20.4
Palatal length	56.4	56.8
Mastoidal width	40.0	38.7
Alveola length	19.9	21.0
Width at M^3	33.6	34.5

(iii) Skull

The measurements tabulated in table 11 show the skulls of males (see plate 7) are on the average significantly larger than those of females and are narrower in the post-orbital region, as is also the case with the Devil.

The mean skull dimensions are expressed as a percentage of the condylo-basal length (see table 12) to give an indication of proportions. Only very slight sexual dimorphism is indicated.

The sagital crest was slightly higher in the larger and apparently older animals.

Tooth wear was noticable to varying extents but in no instance was it found to be severe. Tooth fracturing was found to occur in many instances and any tooth may be affected.

The normal dental formula of I.4/3; C.1/1;P.M.2/2; M.4/4; was found in every animal save Reg. No. 1964:1:210♂ in which a malformation of the molars occurred. The right M^3 lacked the inside cusp, though this may have been due to fracturing at some time, and the right M^4 was rudimentary and similar in size to an incisor.

No evidence of decay in the teeth was found in any member of the Icena series.

(iv) Pelage

The Quoll is dimorphic in pelage colour and the differing phases are commonly referred to as "blacks" and "greys". Both are marked with 60 to 80 white spots of from 5 mm. to 20 mm. in diameter which are haphazardly distributed over most of the body. Twelve (24%) of the Icena series were of the black phase and 37 (76%) were of the grey phase. Gould (1863) found a predominance of the grey phase animals and Batey (1907) found a predominance of greys over blacks in the Sunbury district of Victoria.

The main pile of the body fur reaches a length of 20 mm., is dense and of a soft texture. The two colour phases differ only by virtue of the colour of the subterminal zone of the body fur. In both, the basal 75% is a dark slaty grey slightly paler on the ventral surface. In the "blacks" the whole of the terminal 25% is black except on the ventral surface where it has a brownish tinge. In the "greys" the greater part of the terminal 25% is sandy yellow with only the extreme tips black. On the ventral surface the terminal 25% is pure white. The guard hairs reach a length of 35 mm. and in both phases the dorsals are a uniform black throughout their whole length. The ventral guard hairs of the "blacks" are a reddish-brown while those of the "greys" are entirely white. In both forms the body fur and guard hairs in the spotted areas are pure white for their whole length.

The hair on the feet rarely exceeds 5 mm., is a reddish-brown in the "blacks" and white in the "greys".

The ears are naked internally, except near the tip Externally, sparse hairs reach to 2 mm. They are black in the "blacks" and white in the "greys".

The hair on the tail is harsh in texture and is longest on the terminal half where it usually exceeds 40 mm. and occasionally reaches to 80 mm. In the black phase it is a uniform colour except for a tendency to brownish on the distal under side. In the grey phase the tail has a fox-like appearance with the hairs on the dorsal surface being sandy yellow with a slight black tip and those on the ventral surface being pure white. In both phases the basally grey body fur is present on the proximal portion of the tail but lessens posteriorly and is absent on the distal portion.

The vibrissae of the black phase are all black whereas those of the grey phase may be black, brown or white. The mystacial reach to 60 mm. with up to 25 in each set, the genal to 60 mm. with up to 8 in each set, interramal to 30 mm. with up to 4 per set, and supraorbital to 45 mm. with up to 4 per set.

(v) Breeding

Of the 13 females collected, only one was found with an unoccupied pouch and she showed no signs of breeding. She appeared to be a mature animal and the body weight of 740 gm. was considerably greater than the lightest breeding female. The pouch opening of 35 mm. was in common with the lactating females but the pouch depth of 5 mm., forward of the anterior edge of the pouch, was considerably less than most. Nipples reached to 1 mm. An examination of the reproductory organs revealed no obvious signs of pregnancy.

Of the 12 lactating females, 10 carried the full complement of 6 young (see plate 8). The remaining two carried 5 young each, the unoccupied nipples being the posterior and anterior right respectively.

Four sets which came to hand from the Icena area just prior to the collection of the series under discussion have been included in table 13.

The pouch opening, measured in its normal relaxed position on dead animals, ranged between 30 mm. and 40 mm. in width. Pouch depth ranged from nil in the case of Reg. No. 1964:1:155 with the nearly new-born young, to 25 mm. in the case of 1964:1:205 with six young of a crown-rump length of 22 mm.

The interior of the pouch appeared clean with hair growing from the whole area. That originating in the vicinity of the nipples ranged to 15 mm. in length and that nearer to the pouch opening to 30 mm. In the "blacks" it was pale brown with a pinkish stain. In the "greys" it was originally white but had now become stained to a pale pinkish brown. It was sufficiently dense and tangled to give support to the new-born young and its presence may also assist in maintaining a suitable pouch environment in the early period of the growth of the young.

Nipple complement was invariably 6. In Reg. No. 1964:1:155 with a crown-rump of 6 mm., they reached 2 mm. in length and the tip, within the mouth of the young, was slightly swollen to 0.5 mm. Nipples lengthen with the growth of the young and in Reg. No. 1964:1:165, with a crown rump of 18 mm. they reached to 8 mm., the tip within the mouth of the young being enlarged and laterally compressed to 2 mm. The new-born young were relatively undeveloped except for the front feet in which the toes were prominent. The hind legs were mere buds and there was no obvious development of the ears, eyes or nose.

The colour phase which the young eventually assume is determinable from the time they attain a crown rump length of 10 mm. At this stage a grey pigmentation has developed in the nose of the "blacks", while in the rest it remains white. This feature becomes more noticeable as the young develop further.

The sex of the young is easily determinable after they have attained a crown rump length of about 18 mm.

Vibrissae and hair begin to erupt in the facial regions at a crown rump length of 25 mm.

TABLE 13. An analysis of 16 sets of pouched young of the Quolls collected at Icena, Gladstone. Reg. Nos. 1964:1:107 to 112 were collected prior to the main series. 1964:1:107 was captured with six young but lost one in transit. ° indicates "black" ♀ parent.

Reg. No.	Black			Grey			Total	Av. crown-rump length in mm.	Date collected
	♂	?	♀	♂	?	♀			
1964 : 1 : 107		1			4		5 (+1)	15	5.VII.1964
1964 : 1 : 108		3			3		6	17	5.VII.1964
1964 : 1 : 111		2			3		5	11	26.VI.1964
1964 : 1 : 112		1			5		6	15	26.VI.1964
1964 : 1 : 129				2		4	6	22	21.VII.1964
1964 : 1 : 149				5		1	6	23	23.VII.1964
1964 : 1 : 155							6	6	27.VII.1964
1964 : 1 : 164				1		5	6	22	25.VII.1964
1964 : 1 : 165			1			5	6	18	25.VII.1964
1964 : 1 : 169	2		1	1		1	5	30	25.VII.1964
1964 : 1 : 173°		1			4		5	17	25.VII.1964
1964 : 1 : 183°		2			4		6	15	26.VII.1964
1964 : 1 : 190			2	2		2	6	25	27.VI.1964
1964 : 1 : 193	2		1			3	6	23	28.VII.1964
1964 : 1 : 195			1	3		2	6	26	28.VII.1964
1964 : 1 : 205				1		5	6	22	29.VII.1964
Totals	4	10	6	15	23	28	92		
	20 Blacks			66 Greys			6 Indeterminable		

TABLE 14. An analysis of the stomach contents of 31 Quolls collected at Icena in July, 1964.

Materials found in stomachs	Instances of occurrences
Unidentified flesh	4
Unidentified fur	4
Wool	1
Unidentified feathers	1
Green vegetable matter	4
Dead grass	10
Corbie grubs to 30 mm.	5
Earth worms	2
Nematodes to 40 mm.	1
Excess water-like fluid	5
Empty	5

An analysis of 16 sets of pouched young from Icena (see table 13), based on the above criterions, revealed that of the 92 pouched young therein contained, 86 were determinable for colour phase. Of these 20 or 23.3% were "blacks" and 66 or 76.7% were "greys". This proportion is nearly similar to that of the adult sample. The sex of 53 young was determinable, 19 (36%) being males and 34 (64%) females. This sex ratio is in reverse to that found in the sample of adults under discussion. Testes of males ranged from 14 x 11 mm. to 17 x 13 mm.

(vi) Stomach Contents

Thirty-one of the stomachs were examined immediately after skinning and the contents found to be poorly masticated. Both animal and vegetable matter were represented (see table 14). Most of the Quolls collected from the areas of agricultural land were found to contain Corbie grubs (*Oncopera* sp.) which is a common pasture pest in the areas of agricultural development (Evans 1943).

In the larval stage *Oncopera* lives in a subterranean burrow by day and emerges at night to feed on surface vegetation. In most instances where larvae had been ingested, other food items were also present, but one stomach was found to be filled with larval skins only.

Many stomachs contained small amounts of dry grass, which appeared to have been taken in the course of feeding on Corbies. Two Quolls collected from a wet turnip paddock were found to have been feeding on earth worms.

Green vegetable matter was present in odd stomachs. In some instances this appeared as if it may have been taken fresh but in most it appeared similar to the stomach contents of Wallabies and could have been scavenged from the site where Devils had eaten a Wallaby. One stomach contained a quantity of nematodes of about 40 mm. in length and similar to a parasite commonly occurring in the stomachs of Wallabies. These may also have been ingested while scavenging.

The occurrence of the invertebrate food items in these stomach samples suggests that the Quoll probably takes other pasture pests and the adults of *Oncopera* sp. during the summer months. Sharland (1962) lists frogs and lizards as part of their diet. Mollison (1961) records mortalities on poisoned baits of apples, carrots and a bran-pollard mix. Their highly developed carnivorous dentition suggests a diet of small mammals and birds and their powerful sharp claws equip them for arboreal activities. No doubt they prey to some extent on roosting birds ; but the mixed nature of the food items indicates that they are unselective opportunist feeders.

(vii) General Comments

All the Quolls collected were free from wounds or lesions of any kind and they exhibited no visible marks from fighting. Though they probably run the Wallaby pads they do not fall victim to snares as do the Devils, their smaller size and stealthy movement enabling them to avoid the noose.

Ectoparasites were collected from a range of Quolls and have been deposited in the National Insect Collection, Canberra. Determinations available at the time of writing, from this series and other samples collected by the author, B. C. Mollison and T. Andersen, are listed in table 15.

TABLE 15. Ectoparasites collected from Quolls.

ACARINA

Ticks (determined by Dr. F. H. S. Roberts).

Ixodes tasmani. Sandford, (nymphs) 8.V.1961; Icena, (nymphs) 13.V.1961; Mt. Wellington, (nymphs & larvae) 12.XI.1961.

I. antechini. Maydena, (nymphs) 9.II.1961 ; Icena, (nymphs) 13.V.1961.

I. fecialis. George Town, (nymphs) 12.III.1962; Icena, (♀♀ & nymphs) 21-30.VII.1964.

Mites (determined by Mr. R. Domrow)

Andrecacarus radfordi. Icena, 13.V.1961.

Laelaptidae sp. George Town, 12.III.1962.

INSECTA

Fleas (determined by Dr. G. M. Dunnet)

Pygiopsylla hoplia. Maydena, 9.II.1961 ; Kingston, 16.III.1961; Sandford, 8.V.1962 ; Lesley Vale, (♂♂ &♀♀) 26.VII. 1962; Icena, 21 - 30.VII.1964.

P. zethi. Kingston, 16.III.1961; Sandford, 8.V.1962.

Acanthopsylla rothschildi nercis. Maydena, 9.II.1961.

A. sp. Icena, 21-30.VII.1964.

Stephanocircus dasyuri. Kingston, 16.III.1961 ; Mt. Barrow, 19.V.1961; Mt. Wellington, 12.XI.1961; Sandford, 8.V.1962; Lesley Vale, (♂ & ♀♀) 26.VII.1962.

S. simsoni. Maydena, 9.II.1961.

Uropsylla tasmanicus. Icena, (♂ & ♀♀) 13.V.1961 ; Sandford, 8.V.1962; Lesley Vale, 26.III.1962.

Small parasitic maggot-like larvae were found imbedded in the skin of the ears and scrotum of many animals. These have recently been identified as the larva of the flea *Uropsylla tasmanicus* by R. M. Warneke, Fisheries and Wildlife Department, Victoria. (pers. comm.)

The inclusion of mites in a sample of parasites collected from Quolls at Ieena on 13:V:1961 resulted in the description of a new genus and species *Andreacarus radfordi* Domrow (1963). This mite was also recorded from the endemic Tasmanian Pigmy Possom *Eudromicia lepida* at Greens Beach on 13:VIII:1961 (J. H. Calaby, pers. comm.).

Many Quolls had large cyst-like lumps in the wall of the small intestines and these were found to contain filariids (Munday 1966).

The general condition of the animals was very good. Most carried heavy subcutaneous and visceral fat deposits though in no instance was this as extreme as in the Devils. This parallels the observations of Weindorfer and Francis (1920) who found that its condition is invariably poor in summer but fat in winter.

In north-eastern Tasmania the Quoll was found to co-exist with the Devil and although its diet differs somewhat from that of the Devil it also appears to benefit from the initial effects of settlement and land utilisation. With pasture establishment comes an increase in the supply of invertebrate food items such as worms and pasture pests and it is apparently an effective predator on these as well as small vertebrate animals. Though normally a ground dweller it is also a good climber and often uses this facility in its search for food.

It does not appear as gregarious in its feeding habits as the Devil but initial collecting indicates that a pair often hunt and feed together.

It normally hides by day in a nest formed with any available material and secluded in dense undergrowth, hollow logs, beneath buildings, holes in the ground or any such retreats.

In north-eastern Tasmania it is possibly more numerous than ever before and like the Devil it appears to be spreading, though perhaps not as spectacularly. Its feeding habits render it a lesser pest to the primary producer than the Devil and it is not likely that direct control measures will have to be taken against its numbers. As previously mentioned, it is subject to some mortality where Devil control is necessary and no doubt would likewise suffer if rabbit trapping or poisoning were undertaken on a large scale within the areas of its population. However, while it remains free from epidemic diseases that have in the past decimated whole populations in Tasmania and south-eastern Australia, (Wood Jones 1923), I see no reason why it should not continue to thrive for many years.

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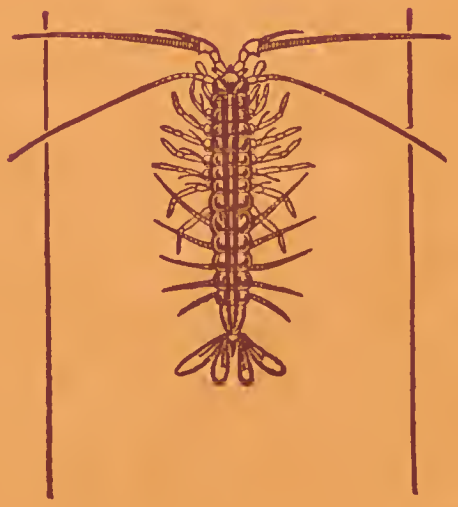

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THE MURIDS AND SMALL DASYURIDS IN TASMANIA

Parts 1 and 2

by
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Part 1. INTRODUCTION

Except for the water rat (*Hydromys chrysogaster*), a commercial fur-bearer, and the three exotic murids which are subject to pest control operations, the murids and smaller dasyurids of Tasmania have not been directly affected by human interference as have the larger mammals. However, the drainage and clearing of river flats, tea-tree swamps and other areas of suitable habitat has undoubtedly affected their status.

Little research had been undertaken on these animals in Tasmania until recently. In the autumn of 1963 an investigation was commenced by the author into the distribution, status and life histories of the murids and small dasyurids. As various rodents and small dasyurids are found in similar habitats and are taken indiscriminately in traps, it was thought desirable and convenient to study them all at the same time.

As it is intended to publish results of the investigations as data accumulate it was thought advisable to review the information available on the Tasmanian forms at the commencement of the study. Numerous endemic species of Muridae and *Antechinus* are described in the older literature but most of these have been relegated to synonymy. (See Iredale and Troughton 1934).

Today only seven species of Muridae are recognized in Tasmania, including three exotics. An additional species is recorded from fragmentary sub-fossil remains of the lower jaw and associated incisors (J. A. Mahoney, personal communication). One species is endemic and two differ subspecifically from their mainland relatives.

Guiler (1958) reported the capture of a specimen of *Rattus* and stated that it probably belonged to the *assimilis* group. No other investigator has recorded rats of *assimilis* type in Tasmania and Guiler's determination is surely an error. He (Guiler 1959) has also reported the occurrence in Tasmania of *Ascopharynx cervinus* (Gould) (=*Notomys cervinus*), a species normally found in the desert areas of South Australia. This record has been discussed by Sharland (1962) who suggests that the specimens in question were introduced from mainland Australia and subsequently escaped or were released. The present author agrees with Sharland.

Two species of *Antechinus* occur and both of these have been shown to be subspecifically distinct from their mainland representatives. One species of *Sminthopsis*, which occurs also on the mainland, is found in Tasmania.

RODENTIA : MURIDAE

Hydromys chrysogaster Geoffroy

This indigenous species is Tasmania's only true water rat. It is widely distributed with a habitat range extending throughout the entire drainage system from highland lakes to tidal rivers, ocean beaches and rocky seashores.

It hides by day beneath any cover which will afford seclusion and becomes active at dusk. Its food consists of a wide variety of organisms, including molluscs, crustaceans, fish and a certain amount of vegetable matter (Lord and Scott 1924). It is a notorious scavenger and the angler risks losing his catch if he leaves it unattended near the water's edge after sunset. It causes considerable damage to bundled fishing nets in its efforts to secure edible remains of the catch.

The water rat is only partly-protected and can be taken under licence annually between 1st May and 31st July. The pelts are of commercial value because of the quality of the fur, but the number sold are of little importance to the maintenance of the species or economically.

Rattus lutreolus velutinus (Thomas)

The velvet-furred rat, Tasmania's most common indigenous species, occurs in a wide range of habitats from coastal swamp-land to sub-alpine rain forest. Variations in colour and size resulted in its being described several times as different species (Higgins and Petterd 1883; 1884 *a*, *b* and *c*).

As recently as 1934 it was still thought that two closely-related native species of *Rattus* occurred in Tasmania (Iredale and Troughton 1934), but today these are considered to be synonymous, and only one form is recognized which is considered subspecifically distinct from the mainland one (Troughton 1965).

Rattus rattus (Linnaeus)

The black rat was accidentally introduced to Tasmania with early settlement and subsequently became widely established as a bush and house-dwelling animal. Its spread was no doubt greatly assisted by the settlers and miners. As these pioneers penetrated more deeply into the uninhabitated parts of the state to establish farms and mining ventures, so the rodents followed and capitalized on the new environment and food supply provided by man. However, the fact that it was collected in seemingly unaltered bushland, together with its considerable variability in colour confused some early naturalists and resulted in its being described under a number of different specific names as endemic Tasmanian rodents (Higgins and Petterd 1883; 1884 *a*, *b* and *c*). Even Oldfield Thomas accepted some of these as valid species for a time. As more material became available the mistaken determinations were corrected (Lord and Scott 1924).

This rat occurs most commonly in association with human settlement and seeks the shelter of man-made constructions. It is a competent burrower and will excavate beneath foundations or in the banks of streams, at times creating quite complicated burrow systems.

Its numbers in rural areas have occasionally reached plague proportions, such occurrences usually being local and influenced by an abundant food supply such as grain. Because of modern harvesting methods and the introduction of highly-improved poisons, it rarely becomes more than a minor pest.

It is highly predacious and is capable of taking birds in excess of its own size. I have personally seen rats kill domestic chickens twice their own weight by seizing the birds by the head and retaining hold despite their violent efforts to free themselves. Whenever possible, victims are dragged away from the site of the kill to be consumed in some secluded corner. It feeds on a wide range of animal and vegetable foods and is an excellent swimmer on or beneath the surface.

The black rat is declared vermin under Tasmanian state law.

Rattus norvegicus (Berkenhout)

The brown rat was accidentally introduced to Tasmania during the early years of settlement, and has for many years been a pest in suburban and built-up areas and occasionally around farms. It seldom becomes established in bush communities but its preferred habitat is the environment of sewerage systems, warehouses, wharf areas, city rubbish tips etc. where it can usually find a plentiful food supply. Despite modern methods of control it remains an important pest of concern to public authorities, produce merchants, and warehouse tenants.

Its fur is usually grey but occasionally half-white animals are found. It can attain a body weight in excess of 300 grams: such large individuals being almost equal in size to the native Water Rat (*Hydromys*). It has a predatory disposition and will take chickens or ducklings of weights in excess of its own. It is an excellent swimmer on or beneath the surface. It is declared vermin under Tasmanian state law.

Mus musculus (Linnaeus)

Introduced accidentally to Tasmania by the early settlers, the European house mouse rapidly spread and became established in houses and other buildings and in fields. No doubt its spread was greatly assisted by the transport of oaten chaff. It could safely remain inside bags of this fodder which were carted in quantity and used to feed horses, the principal means of locomotive power in the early days. Likewise stacks of oaten hay, often held for months before being cut into chaff, provided ideal shelter and an ample supply of food which promoted extensive breeding resulting in local population explosions.

In 1882 it occurred in numbers in the Ringarooma district of north-eastern Tasmania. Specimens were collected by Mr. A. Simson and forwarded to Messrs. Higgins and Petterd who described it as a new endemic rodent *Mus simsoni* (Higgins and Petterd 1883), apparently being completely deceived by its ability to thrive under Tasmanian field conditions.

With the replacement of the horse by the motorised vehicle and the resultant decrease in the number of stacks of oaten hay, the field population of *M. musculus* has been greatly reduced. Its occurrence today is usually restricted numerically, presumably because of the limited availability of suitable food. It is well adapted to a wide range of habitats and can be taken in relatively unaltered bush where it is not in any way dependent on man-made alterations to the environment.

Pseudomys higginsi (Trouessart)

The long-tailed rat is an endemic Tasmanian species occurring in the myrtle rain-forest and wet sclerophyll forest.

A number of specimens were collected in the Waratah area by O. L. Adams and others towards the end of the nineteenth century and Finlayson (1933) found it plentiful in the beech and pine scrubs in Cradle Valley in 1931.

Mastacomys fuscus Thomas

A rare and localised rat, the broad-toothed rat was originally described by Thomas (1882) from a single Tasmanian specimen. In 1931, Finlayson (1933) collected five specimens from Cradle Valley, north-west Tasmania, and thereby established the fact that it was still in existence. He amplified Thomas's original description.

The Tasmanian Museum holds two spirit specimens (ZC41) collected at Port Davey, south-west Tasmania in 1950. Both this area and Cradle Valley carry a primitive Button Grass (*Mesomelaena sphaerocephala*) type of habitat to which this rat appears to be mostly confined. Its presence in sub-fossil cave deposits suggests that it was far more plentiful during former times when its preferred habitat was presumably more extensive and unaffected by man. It does not appear to have been able to adapt itself to the changing environment.

Though it has since been recorded from mainland localities (see Calaby and Wimbush 1964) it is nowhere plentiful, and has been recognized as one of the Australian mammals, the survival of which is threatened (Calaby 1963).

MARSUPIALIA : DASYURIDAE

Antechinus minimus minimus (Geoffroy)

The little marsupial-mouse is a rare and apparently localised animal which was afforded subspecific status by Wakefield and Warneke (1963) when they showed that a different race occurred on the mainland. The Queen Victoria Museum has two males collected at Magnet (near Waratah) in February 1904 but these are in poor condition and without skulls, and confirmation of the original determination is now difficult. Another was collected at Blue Rocks, Flinders Island in June 1961. It occurs on isolated Maatsuyker Island south of Tasmania and representative specimens from there are held in both the Queen Victoria Museum (1959:1:13) and the Tasmanian Museum. Single individuals came to hand in 1944 from Selbourne in the north and from South Mt. Cameron in the north-east of the island.

Though it has been recorded from widely ranging areas it is nowhere plentiful and occurrences indicate that it prefers the more open sedgeland habitat usually shunned by *A. swainsonii*. Additional distributional data, the type specimen, and early taxonomy of the species, are discussed by Wakefield and Warneke (1963). Three species of *Antechinus* had been described from Tasmania prior to 1882 and subsequently six more were described by Higgins and Petterd (1884). These have since been shown to be synonyms of the two species dealt with here.

Antechinus swainsonii swainsonii (Waterhouse)

Though locality records of Swainson's marsupial-mouse are few, its habitat preference indicates that it is

probably the more common of the two *Antechinus* species occurring in Tasmania. A different subspecies occurs in the south-eastern part of mainland Australia.

It was collected in the Waratah district at the end of the last century and the Queen Victoria Museum holds specimens from Kindred (1924) and Fingal (1940). Wakefield and Warneke (1963) give additional locality records, and discuss its taxonomy and synonymy.

Sminthopsis leucopus (Gray)

There are fewer records of the white-footed marsupial-mouse in Tasmania than of any other marsupial and its status is unknown. It has been recorded from a few isolated localities on the north and east coasts but recent collecting has resulted in its discovery in northern inland areas. Future investigation may yet prove it to be more common than existing records indicate.

Gyomys or *Leggadina* sp.

A quantity of sub-fossil bone material collected from the floor of a limestone cave at Flowery Gully in 1959 contained representatives of most Tasmanian terrestrial vertebrates. Amongst these were nine fragmented lower jaws, mostly with associated teeth, which have been determined by Mr. J. A. Mahoney as belonging to either one of the above genera. This is the first and only record of this rodent in Tasmania and it is believed to have died out now.

Part 2. *Rattus lutreolus velutinus* (Thomas)

ABSTRACT

The results of three years (1963 - 1965) collecting and field observations on the Velvet-furred Rat *R. l. velutinus* are recorded.

The known distribution is mapped and the various habitat preferences described.

A full description of the rat is given together with tabulated measurements of the plastic features and skull. From the degree of molar tooth wear it has been found possible to assess the approximate age of the rats. This, in turn, has shown the normal life expectancy to be a little over one year but that odd individuals will survive two years.

Notes are given on habits and the formation of runways and burrows and the selection of nest sites. The availability of food items is discussed and the specific characteristics of faecal pellets given.

Breeding has been found to be prolific and seven litters totalling 27 young have been born from one captive pair in eleven months. In the wild state, breeding is usually restricted to a summer season.

New born young are described and their rate of growth and development given. Sexing by scrotal pigmentation has been found practicable from birth. Details of trapping methods and the baits used on about 5,700 trap nights are given together with the catch results and catch expectancy.

Field studies using fingerling fish tags to individually mark rats have been in operation and the results to date have given information on range, movement, breeding and life expectancy.

A series of parasites has been collected and some determinations of these are tabulated.

The influence of natural predation and the effect of habitat destruction is discussed.

DISTRIBUTION

Recent investigations have shown that this rat has a wider distribution than was at first anticipated. Some habitat types appear particularly favourable and are more densely populated, but it has now been found occurring in more or less significant numbers over the greater part of Tasmania (see map, figure 1). It occurs in greatest abundance in the western half of the island where much of the country lacks human settlement or influence and still remains in its natural state. Though it may once have occurred in similar density in the eastern half, this is not the case today as here it is generally confined to a few remaining areas still unexploited.

Its apparent absence from large areas of the midlands appears to be correlated with the grazing of sheep and cattle and the development of agricultural land. This correlation extends to the east and north coastal regions and the central plateau, where this rat may reasonably be expected to occur. It is reasonable to expect that clearing and agriculture would remove the native rodents, but there remain large areas of almost unimproved grassland and light bush which are utilized solely for grazing. At first appearance such areas seem to be a suitable environment, but except for small isolated colonies in rough or swampy places which are relatively inaccessible to stock, *R. l. velutinus* remains unrecorded. This is probably due to a combination of several factors, such as the burning of vegetation as it becomes overgrown, disturbance by the trampling of stock, and the close grazing of surface vegetation which provides necessary cover.

The distribution map shows the localities from which specimens have recently been collected. The shaded area is the present known range, based on sampling of habitat types. Amongst the collections of the National Museum, Melbourne, is a skin and skull (Reg. No. R5447) from King Island, Bass Strait, December 18, 1887. The extensive agricultural development of the island may have since annihilated the population. *R. lutreolus* has recently been collected on Flinders Island by Miss Jeanette Partridge (pers. comm.)

A small amount of sub-fossil skeletal material from the floor of a limestone cave at Flowery Gully (see map) mostly mandibular and maxillary fragments, was determined as this species by Mr. J. A. Mahoney. This material is held in the collections of the Queen Victoria Museum.

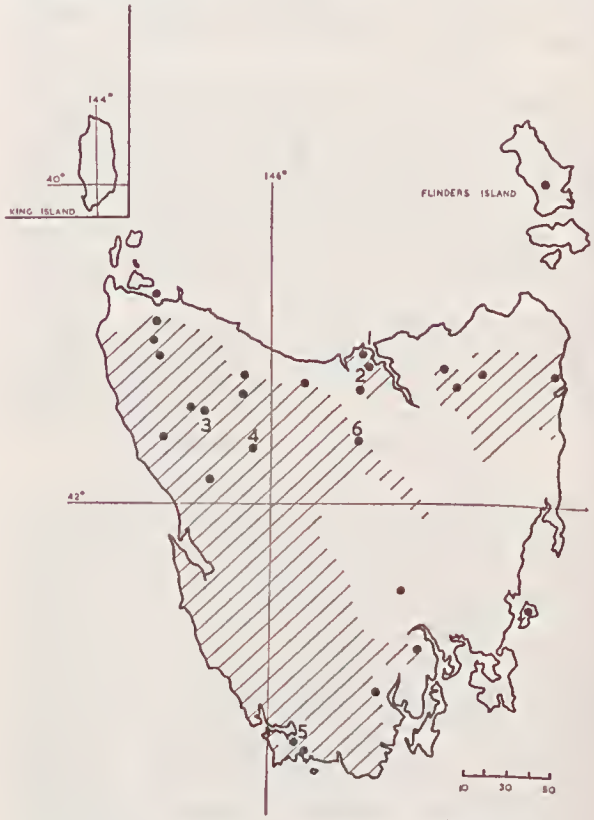

Figure 1. Localities from which *R. l. velutinus* has been collected and the probable overall distribution based on available habitat. Places mentioned in the text are: 1. Greens Beach. 2. Flowery Gully. 3. Waratah. 4. Cradle Mountain. 5. Port Davey. 6. Great Western Tiers.

HABITAT

R. l. velutinus commonly occurs in three distinct habitat types with a gradual decrease in numbers in marginal areas. In order of decreasing importance the principal habitat types are the Myrtle-predominant temperate rain forest, the Button grass sedgelands, and the coastal swamp lands. The marginal areas include

eucalypt forests, belts of poa tussock, tea-tree and heath-land and other suitable vegetation occurring as an ecotone.

The rain forests occupy extensive areas in the western half of the island and range in altitude from sea level to 3,500 feet (Jackson 1965). This habitat also occurs in the north-eastern highlands and on the steep slopes of the Great Western Tiers. These areas are subjected to widely differing extremes of temperature. In the winter months of April to September the more elevated areas are often covered with up to a foot of snow for several weeks at a time and temperatures might fall to 10°F. In mid summer this same habitat might experience extreme high temperatures, up to the mid nineties. Mean annual rainfall varies greatly and may exceed 100 inches in parts of the western highlands but in nearby similar habitat in the north-east, south, and on the Great Western Tiers, it may be as little as 40 inches (Langford 1965).

The forest canopy is a complex association of *Nothofagus cunninghamii* (Beech), *Atherosperma moschatum* (Sassafras), *Eucryphia lucida* (Leatherwood), *Phyllocladus rhomboidalis* (Celery-top pine), *Anodopetalum biglandulosum* (Horizontal scrub), and *Eucalyptus* spp. which vary in density and relative abundance according to soil, aspect and fire influence (Jackson 1965). Similar variations occur in the understorey which includes *Olcria argyrophylla* (Musk), *Pittosporum bicolor* (Cheesewood, Tallow-wood), *Drimys lanceolata* (Native pepper), *Persoonia gunnii* (Gunn's persoonia), *Anopterus glandulosa* (Laurel), *Dicksonia antarctica* (Soft tree-fern). The forest floor is heavily-littered with decaying debris and rotting logs and stumps, over most of which a carpet of damp green moss grows.

The sedgelands (see plates 1 and 2) occur principally in the western half of Tasmania and have a mosaic-like distribution as openings in the rain forest. They are associated with high rainfall and are subject to similar climatic conditions as the former habitat type. The dominant plant species is *Mesomelaena sphaerocephala* (Button grass) which is interspersed with *Restio australis* (Mountain cord-rush) and *Lepidosperma filiforme* (Common rapier-sedge). *Imperata cylindrica* (Bladey grass) and *Poa caespitosa* (Tussock grass) occur as isolated patches. A narrow ecotone of wet scrub includes *Sprengelia incarnata* (Swamp heath), *Epacris gunnii* (Gunn's heath), *Boronia rhomboidea* (Diamond boronia), *Baeckea gunniana* (Shrubby heath-myrtle), *Monotoea* sp. (Broom-heath), *Leptospermum* sp. (Tea-tree), *Oxylobium ellipticum*, *Gleichenia alpina* (Dwarf coral-fern) and stunted *Eucalyptus gunnii* (Gums). Sphagnum moss is plentiful in the wet and swampy areas and in some instances occurs as bogs up to several feet in depth.

Coastal swampland habitat is less extensive than the previous types and occupation by rats is restricted to suitable areas on the north and east coast which are not unduly affected by grazing. Colonies in these areas are usually numerically strong and often extend to dry elevated banks some distance away. The swamps may be partly or completely dry for several months during summer thus enabling the rats to form runways beneath the vegetation, but as they fill with the autumn rains the rats apparently withdraw to the drier banks.

The soil is mostly light and sandy and the vegetation typically coastal. The major swamps are usually surrounded by dense stands of *Melaleuca ericifolia* (Tea-tree) while the adjacent low-lying and gently sloping areas support an abundance of Tea-trees including *Melaleuca ericifolia*, *M. squarrosa* and *Leptospermum scoparium*. Heaths include *Epacris lanuginosa*, *E. impressa*, *Sprengelia incarnata* and *Leucopogon virgatus*. *Acacia verticillata* (Swamp wattle), stunted *Banksia marginata* (Honeysuckle), *Casuarina distyla* (She-oak), *Dianella tasmanica* (Rush lily) and *Lepidosperma filiforme* (Common rapier-sedge) are also numerous. This complex vegetation grows very densely and in the parts not subjected to recent burning may exceed six feet in height. On the more elevated areas its density decreases and it is partly replaced by *Pteris aquilina* (Bracken fern) with an over storey of *Eucalyptus* spp., *Casuarina strieta* and *Banksia marginata*.

R. l. velutinus occurs prolifically throughout these three habitat types and to a lesser degree in the ecotone, provided fire or over-grazing by domestic stock has not destroyed the vegetational cover. When this occurs recovery is slow and it may be many years before regrowth and ground cover is sufficient to allow repopulation. Habitat destruction by fire is believed to be the major factor limiting the population of *R. l. velutinus* but it must also be borne in mind that firing has always influenced the ecology and is less extensive since the extinction of the aborigines (Jackson 1965).

DESCRIPTION

The description is based on a series of 207 skins and associated skulls and 28 spirit specimens held in the Queen Victoria Museum. They have been assembled in the course of field studies conducted in 1963, 1964 and 1965 and were collected in a wide range of habitat types.

External characters

In general form (see plate 3) the rat is stout and appears to have little if any neck. The ears are rounded, appearing almost naked, and are greyish-brown in colour. The face is somewhat pointed with the eyes small and set well forward in the head. The iris is deep brown and the pupil black. The naked nostrils are pale flesh pink. The incisors are yellow on the anterior surface and chisel pointed, the lower set being long and slender and erupting to 10 mm. from the gums. The legs are short and the feet stout and sparsely covered with short hair. The claws are strong and usually clear though slight pigmentation may sometimes be noticed beneath the semi-transparent surface. The under surface of the feet is variable but the manus is always paler than the pes. The manus is generally white but in odd individuals it is slightly mottled with grey. The pads of the manus are rounded and smooth, the interdigitals being approximately equal in size. The metacarpals are much larger and more prominent with the outer slightly exceeding the inner in size. The digital formula is 3> 4> 2> 5> 1, the first being greatly reduced and rudimentary. There are four digital rings beneath each toe but the basal rings of the second and fifth digits are usually less distinct.

The pes is generally a dark leaden grey. The pads and digital rings are paler and in some instances almost white. The pads are prominent and vary in size and shape. The inner metatarsal is the largest, the outer metatarsal the smallest, with the digitals being approximately equal and falling between these extremes. The digital formula is 3> 4> 2> 5> 1. There are two digital rings beneath the first toe and five beneath each of the remaining toes, though the basal ring on the fifth toe is less distinct. The hind feet are turned gently inward and the rat is inclined to walk on the outer edge of the pes and toes, which gives a slightly distorted, pigeon-footed appearance.

The tail is shorter than the head and body, stout

and gently tapered. Tail scales are of a leaden grey colour and arranged in about 130 irregular rings which contain up to 20 scales each in the basal region and declining to about 10 in the distal region. The tail is sparsely covered with bristle-like hairs which occur in sets of three, except near the extreme tip where they are reduced to sets of two or singles. They are directed acutely to the distal end and arranged in line between the rings with a set erupting from behind each scale. They are dark brown at the base but paler towards the tip. Length varies to 1 mm. but the central member is the longest in each set.

Nipples are not easily discernable in sub-adults but mature females have invariably been found to have a formula of $2 + 2 = 8$ (see figure 2). This is in contrast to the mainland form which possesses an extra abdominal pair (Wood Jones 1923).

The scrotum become prominent as breeding approaches and may attain a length of up to 35 mm. and a width of up to 25 mm. It is well furred except for the posterior region which is naked and darkly pigmented. This scrotal pigmentation is evident from birth and is useful in determining sex when other external features are undeveloped.

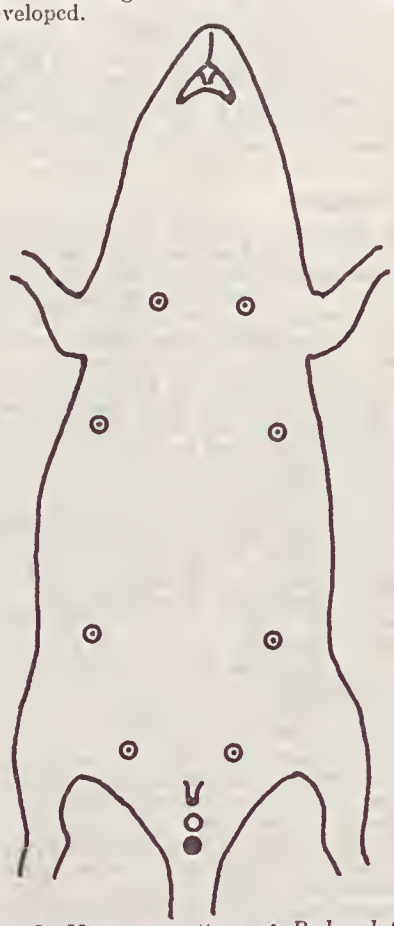

Figure 2. Mammary pattern of *R. l. velutinus*

Plastic dimensions

Plastic measurements were taken as follows :

Total length: From the tip of the nose to the tail tip, measured dorsally with the animal on its back.

Tail: From the base of the tail to the tip, measured dorsally with the tail turned up at right angles to the back.

Ear: From the tragoid notch to the ear tip.

Pes: From the back of the heel to the extremity of the longest (third) toe, excluding the claw.

As the breeding season extends over several months it is usual to find a considerable variation in the dimensions of individuals collected at any one time. In the summer and autumn months when the new season's young become independent they may be trapped along with adults and an overlapping of generations occurs. Table 1 has been arranged to show the weights and basic measurements of progressively aging rats. The data given bimonthly commences with new season sub-adults and carries through to the post-breeding adults. Though the samples given are small it is clear that in rats of equal age males generally exceed females in weight and size. A weight loss following mating is indicated in the males. The heaviest male weighed 159 gm. and was taken on 16.II.1965 from a Tea-tree swamp on the east coast. The heaviest female weighed 158 gm. and was taken on 8.II.1965 from west coast rain forest. She carried six half developed embryos. The relation of body weight to size varies considerably, especially in breeding and post-breeding rats. The largest male collected had a total length of 319 mm. (tail 151 mm.) but its body weight was only 131 gm. It was taken from western rain forest country on 7.II.1965 and was probably in the post-breeding decline. The largest female had a total length of 294 mm. and was the rat quoted above as being of greatest weight.

A comparison of the highland rain forest and coastal swamp land populations showed no significant differences. No sexual dimorphism is indicated in the relative proportion of tail, ear and pes when expressed as a percentage of head and body length.

Pelage

No sexual dimorphism in pelage characteristics could be detected. The fur is soft and dense. It is longest on the top of the rump where it attains a length of up to 20 mm. but decreases to 15 mm. on the shoulder region and flanks and to 10 mm. on the belly. It is a soft leaden grey for the greater part of its length and is slightly paler on the belly. The extreme terminal region is usually a sandy-yellow but this is variable and may be reduced, completely absent, or tipped with black. This creates different composite effects and accounts for the variation in superficial appearance which ranges from tan brown to blackish brown.

The length and density of the guard hairs varies considerably between individuals and this also creates a difference in the composite effect. They are longest in the region of the top of the rump where they may attain a length of up to 50 mm. On the anterior regions and flanks they are shorter and less prominent, and on the belly barely exceed the length of the main pile. They are coarse, and taper to a very fine tip and are a lustrous black except on the belly where they are pale sandy yellow. Pelage colour on the head is similar to that on the body except in the region of the lips where it fades to a soft grey.

Vibrissae are prominent and gently taper over their entire length to a very fine tip. They are generally black though some of the mystacials are pale terminally. Wear and breaking often account for a reduction in the number visible. The mystacials are arranged in five rows, the posterior members being the longest and

TABLE 1. Weights (gm.) and measurements (mm.) of *R. l. velutinus* arranged in progressive age groups of bimonthly intervals. Quotations are for extremes, with mean in brackets, of rats collected only in the month stated, but they have been assembled over the three year period from all types of habitat.

MONTH	SEX	NUMBER IN SAMPLE	WEIGHT	TOTAL LENGTH	TAIL	EAR	PES
Feb.	♂	8	33 - 74 (53.1)	182 - 235 (218.7)	74 - 113 (89.2)	18 - 20 (19.1)	24 - 29 (26.5)
	♀	6	19 - 77 (50.5)	164 - 225 (197.0)	74 - 98 (86.2)	16 - 20 (18.6)	20 - 28 (25.2)
Apr.	♂	13	43 - 104 (77.8)	202 - 270 (240.5)	84 - 115 (100.5)	18 - 21 (20.1)	25 - 30 (28.6)
	♀	5	44 - 82 (62.4)	185 - 254 (221.2)	79 - 120 (97.8)	19 - 20 (19.4)	24 - 28 (26.8)
June	♂	13	60 - 102 (78.4)	207 - 285 (246.2)	91 - 120 (108.9)	19 - 22 (20.2)	26 - 30 (28.4)
	♀	21	52 - 98 (70.5)	219 - 262 (240.0)	94 - 115 (104.3)	19 - 20 (19.7)	24 - 29 (27.9)
Aug.	♂	11	81 - 118 (94.1)	205 - 278 (255.3)	106 - 121 (112.7)	19 - 22 (20.2)	27 - 30 (29.1)
	♀	8	70 - 115 (94.9)	245 - 277 (257.0)	106 - 117 (113.0)	19 - 23 (20.9)	28 - 30 (29.0)
Oct.	♂	5	129 - 149 (139.4)	259 - 298 (280.4)	104 - 131 (117.2)	21 - 22 (21.4)	29 - 31 (30.2)
	♀	5	87 - 114 (105.2)	246 - 265 (253.6)	95 - 110 (103.2)	18 - 21 (19.9)	25 - 30 (27.4)
Dec.	♂	4	118 - 150 (129.5)	268 - 290 (280.0)	110 - 126 (118.0)	20 - 21 (20.7)	29 - 31 (30.0)
	♀	3	75 - 112 (97.5)	254 - 263 (260.0)	103 - 116 (110.0)	20 - 22 (21.0)	29 - 30 (29.0)
Feb.	♂	25	93 - 145 (114.8)	265 - 319 (282.7)	108 - 151 (126.1)	19 - 22 (20.5)	28 - 31 (29.4)
	♀	25	70 - 158 (114.3)	260 - 294 (278.2)	114 - 129 (122.4)	20 - 22 (20.6)	27 - 30 (28.8)

attaining a length of up to 55 mm. They progressively decrease in length and diameter towards the nose, the most anterior reaching to about 10 mm. The upper two rows generally consist of four vibrissae each, the central, five, and the lower two rows, six each. Up to three supraorbitals may be present ranging to 36 mm. in length with the posterior the longest.

Genal vibrissae are not easily discernible but one or two up to 30 mm. long may be present. Interramals are very fine and indistinct, with normally three in the set reaching to 14 mm. Three ulnar carpal vibrissae are normally present and reach to 11 mm.

Skull

The measurements given in table 2 were taken from a series of 60 skulls of rats collected during the summer months from all habitat types. All carried tooth wear indicative of mature animals, probably in excess of one year old. Most skulls had been cleaned by dermestid beetles. Measurements (see figure 3) were made with slide calipers graduated to one tenth of a millimeter. No sexual dimorphism is indicated in the skull proportions.

Molar tooth wear increases with age (see plate 5) and is well illustrated in the skull series when arranged in the order of monthly catches. Because breeding in the wild state is restricted to an annual season, rats taken in any one month can be grouped into an approximate age category by the degree of molar wear. Two easily separable groups can be determined: those in their first year and those in their second year. Odd individuals with exceptionally heavy molar wear sometimes occur and can be separated from the second year rats. These are thought to be those which sometimes survive into the third year. This has been found to occur occasionally in cage studies and in tagging studies of wild rats.

The three age groups are shown in table 3 and the catches for each month over 3 successive years are given for males and females. Though the sample is small some indication of the seasonal variation in population structure can be deduced. Trapping in February produced a total of 67 rats, the sexes being about equal but the new season's young, with teeth barely worn,

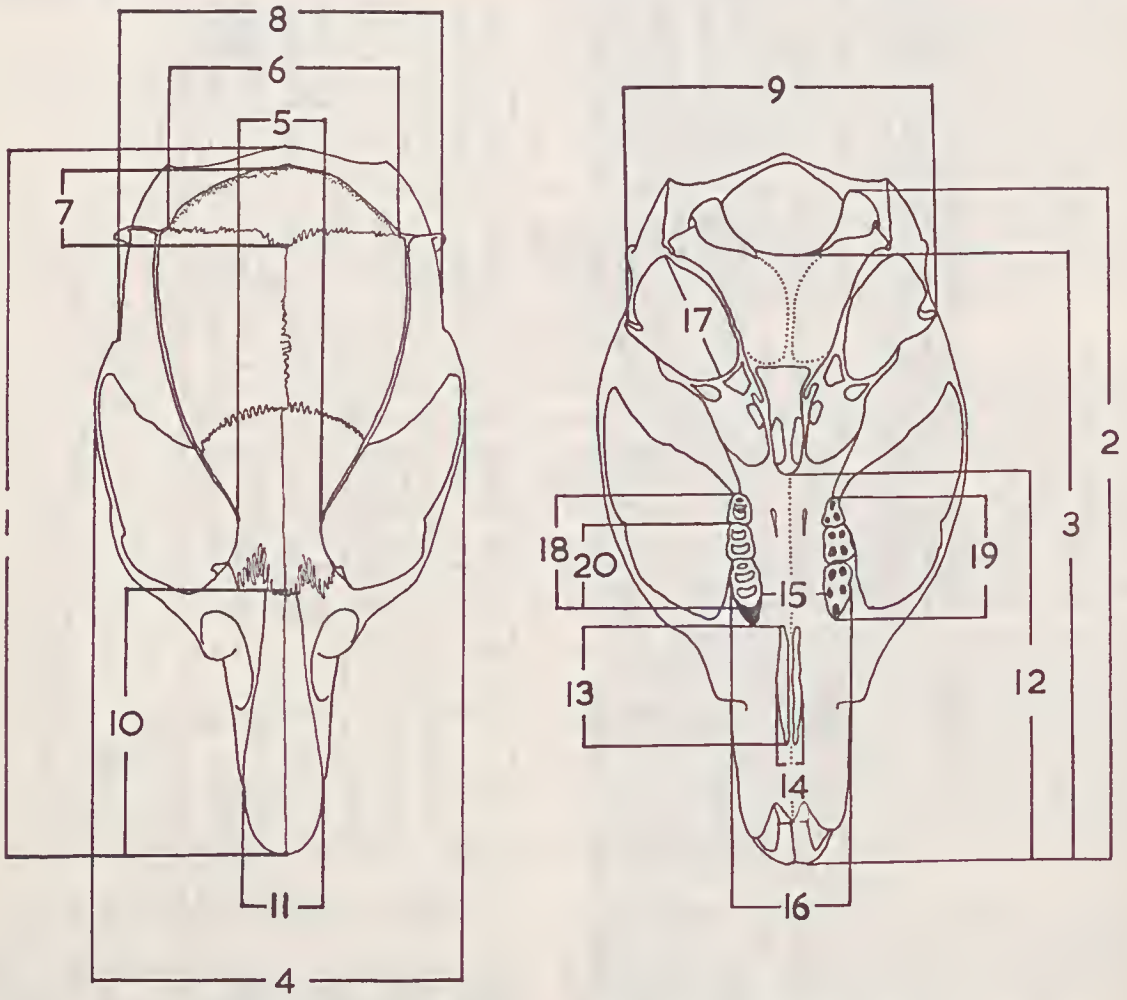

Figure 3. Points from which the skull measurements mentioned in the text were taken.

were very much in the minority. Of the 55 adults, 5 females and 1 male had exceptionally heavy tooth wear and were presumably old rats which had survived two breeding seasons and were into their third year.

In comparison, trapping in June showed a completely different population structure. Rats in their first year were very much in the majority and though many post breeding females, then in their second year, were still surviving, no second year males were caught. By November-December the populations consist primarily of rats approaching the end of their first year with the sexes in about equal proportions.

No rats have been found with abnormal dental development or decay. The length of the upper incisors was variable in the older rats, in some instances differing by as much as 30% between individuals of otherwise

TABLE 2. Comparisons (mm.) of skull measurements of males and females of adult *R. l. velutinus.*

	30 Males		30 Females	
	RANGE	MEAN	RANGE	MEAN
1. Total length	35.5 - 40.5	37.91	36.7 - 40.0	37.87
2. Condylo-basal length	34.5 - 39.0	36.55	35.5 - 38.8	36.65
3. Basal length	32.3 - 36.5	34.22	33.5 - 36.4	34.32
4. Zygomatic width	19.1 - 21.3	20.17	19.4 - 21.3	20.31
5. Inter-orbital width	5.4 - 6.3	5.85	5.4 - 6.1	5.84
6. Inter-parietal length	3.3 - 4.4	3.98	3.4 - 5.0	4.09
7. Inter-parietal width	8.0 - 11.0	9.55	8.0 - 11.3	9.79
8. Cranium width	15.7 - 17.5	16.47	15.8 - 17.4	16.46
9. Mastoid width	15.6 - 17.1	16.35	15.3 - 17.3	16.34
10. Nasal length	13.3 - 15.6	14.19	13.1 - 14.7	14.20
11. Nasal width	3.5 - 4.4	3.99	3.7 - 4.6	4.05
12. Palatal length	19.2 - 21.9	20.61	20.2 - 21.6	20.78
13. Palatal foramin length	5.9 - 7.3	6.67	6.1 - 7.4	6.80
14. Palatal foramin width	1.4 - 1.7	1.52	1.3 - 1.9	1.51
15. Width inside M^1-M^1	2.8 - 4.1	3.33	2.8 - 4.4	3.24
16. Width outside M^1-M^1	7.7 - 8.9	8.24	7.8 - 9.5	8.22
17. Bulla length	5.7 - 6.7	6.29	5.7 - 6.6	6.21
18. Length crowns M^1-M^3	6.1 - 6.9	6.50	6.0 - 7.4	6.52
19. Length alveoli M^1-M^3	6.8 - 7.7	7.20	6.5 - 7.8	7.23
20. Length crown M^1-M^2	4.3 - 5.0	4.64	4.1 - 5.1	4.61

TABLE 3. Number of rats in each age group in the month they were collected over the three year period. Classification is based on the degree of molar tooth wear.

	Age groups of females			Age groups of males		
Month	1st Year	2nd Year	3rd Year	1st Year	2nd Year	3rd Year
J.	0	0	1	0	1	0
F.	5	25	5	7	24	1
M.	2	1	1	0	0	0
A.	5	1	1	12	3	0
M.	3	1	0	4	1	0
J.	20	15	0	12	0	0
J.	1	0	0	2	0	0
A.	5	2	0	11	0	0
S.	0	0	0	2	0	0
O.	3	2	0	5	0	0
N.	5	0	0	5	0	0
D.	4	0	0	4	0	0

approximately equal proportions. Such differences appeared to be caused by lack of wear and subsequent over growth.

HABITS

R. lutreolus has been described as a water loving species and Wood Jones (1923) states that it spends much of its time in the water. Gould (1863) illustrates it swimming. Observations indicate that this is not necessarily the case with the Tasmanian subspecies as much of its preferred habitat has been found to be in steep and well-drained areas. Often its only association with free water is during or immediately after rain. Under swampy conditions its runways are wet and muddy but it shows no desire to avoid them. If the living area becomes covered with water the rats evacuate it in favour of more elevated ground. In some instances runways leading from dry ground have been found to traverse the top of dense vegetation growing in several feet of water. On two occasions rats of the species (or possibly the broad-toothed rat *Mastacomys fuscus*) have been flushed from creekside growth and have jumped into the stream, swum on the surface to the other side and disappeared on another runway. Though it apparently has no objection to wet or muddy conditions under foot and will take to water if circumstances necessitate, it prefers to keep its body fur dry and avoids swimming when possible. Stomach contents do not suggest that it takes food from the water.

Runways and burrows

The structure of runways varies between the different habitat types. In the coastal swampland and sedgeland habitats they are well developed and may form a labyrinth of tunnels, completely or partly concealed beneath the vegetation, and interlinked by well formed pads across the exposed intervening areas. The runways are about one and a half inches across and are formed by the rats chewing away everything which obstructs their path. Exposed woody roots and twigs are gnawed away and regrowth is kept well trimmed. Streams up to two or three feet wide are no barrier as runways have been found which terminate at the water's edge and start again on the opposite bank, the rats presumably jumping the intervening distance. Runways become less distinct as the suitability of the habitat decreases and appear to be used for access to feeding areas and to provide freedom of movement throughout the habitat. Clear well formed runways would also reduce fur soiling by lessening the contact between the animals and wet vegetation.

In the rain forest, runways are not nearly so common. Much of the forest floor is clear of vegetation which might impede the rats' movements and their formation is apparently unnecessary. Faint runways may sometimes be discernible beneath the sheltered edge of logs, or passing beneath rotting timber and upturned stumps; but even in the vicinity of entrances to well-used subterranean retreats they do not attain such prominence as in the swampland and sedgeland habitats.

Sub-surface burrowing is common in the light sandy soils of the coastal swamplands but sites chosen are usually on drier elevated ground and in a patch of dense Tea-tree or similar scrub. They range in extent from a single short burrow to elaborate warren-like excavations over an area of a hundred square yards. Burrows are from one and a half to two inches in diameter and may run in any direction, usually only a few inches beneath the surface. They are often branched, and excavated soil is deposited in a heap at the entrance. These soil heaps are conspicuous but the hole from which the soil was raked is often blocked up and an alternative opening used. Exit holes without spoil and well concealed amongst the debris provide the rats with emergency escapes. Dry grass, leaves and similar vegetation are carried into the tunnels for nesting material. Warrens are used indefinitely by succeeding generations but parts are sometimes abandoned and new sections may be excavated. Even the extensive warrens are occupied by only one family at a time comprising of an adult pair and their several litters of young.

Sub-surface retreats are also common in the rain forest habitat but rarely are these excavated by the rats. Many years accumulation of fallen timber, debris and moss have provided suitable cavities. Holes in rotting logs and stumps are also utilised. Debris and moss makes the entrances inconspicuous.

In the sedgeland habitat the surface burrows are almost completely absent presumably because of the unsuitability of the wet peaty soils. In much of this habitat, seepage would swamp such burrows particularly in the winter months. Their place is taken by tunnels formed in the base of dense Button grass clumps or similar vegetation. This provides for good drainage and elevates the nest sites above the wet ground. Despite much searching only a few such nests have been found in the wild state and these have all been empty. They were situated in the base of Button grass or Poa tussocks and were formed by the rats chewing away surplus material to create cavities about nine inches in diameter. The nest cavaties were heavily lined with dry vegetation apparently removed from the site and the nest chambers were about four inches in diameter.

Feeding and faeces

The diet of *R. l. velutinus* varies with the habitat and season but it is primarily vegetarian. In the coastal swampland and sedgeland habitats it consists of various fine rushes, grass stems and the succulent roots of Button grass. Clumps of Button grass have often been found with the root system almost completely eaten away and beneath the dead or dying plant lies a mixture of loose earth and rejected fibrous root material. In the summer months the new shoots of Button grass are bitten off, husked and eaten. In the rain forests this food source if not available and the rat presumably turns to seeds and other plant foods. The stomachs of rats from rain forest habitat have been found to contain also small amounts of insect material. A sample of six rats collected from a gully in the Great Western Tiers on 9.XI.1965 was found to have been feeding almost entirely on various insect larvae. This was exceptional and is the only instance encountered when the stomach contents of this rat have not consisted primarily of vegetable matter.

Wood Jones (1923) states *R. lutreolus* "will invade the camps of duck shooters in the usual rat fashion". Presumably this refers to tent dwellings. The Tasmanian subspecies rarely if ever invades houses or bush huts. In the Cradle Mountain — Lake St. Clare Reserve in the Tasmanian central highlands there are a number of old shingle huts which provide accommodation for visitors and walking parties. Most are sited in the shelter of forests and are in the midst of good populations of *R. l. velutinus*. They are often invaded by other rodent species scavenging for food but I have never known *R. l. velutinus* to offend in this way.

Cage studies (see later) have shown that *R. l. velutinus* will drink liberally when water is available but is capable of existing for long periods without drink-

Plate 1. Sedgeland habitat near Cradle Mountain. Normal summer conditions.

Plate 2. Sedgeland habitat near Cradle Mountain under two feet of winter snow. July, 1966.

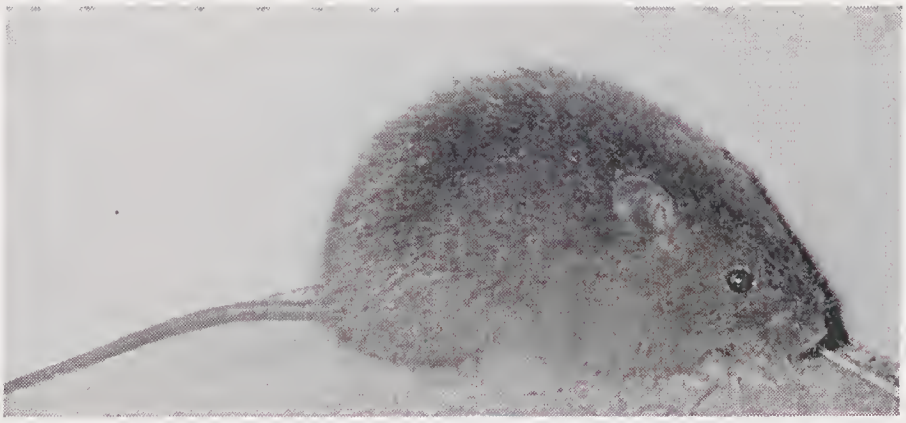

Plate 3. Adult *R. l. velutinus.*

Plate 4. Skull of *R. l. velutinus.*

Plate 5. Molar tooth wear in *R. l. velutinus* at about 3 months, 12 months and 24 months respectively.

Plate 6. *R. l. velutinus* one day old.

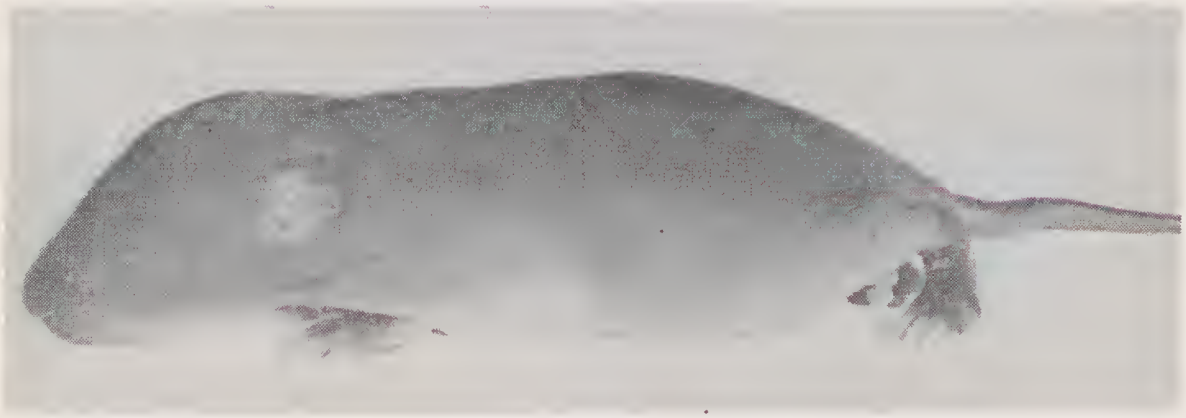

Plate 7. *R. l. velutinus* 12 days old.

ing provided it can obtain reasonably juicy vegetable foods. There are extensive areas in all habitat types where populations are without free water, particularly during the summer months. Here they must survive on the moisture obtained from their food or precipitation licked from the foliage.

R. l. velutinus defaecates and urinates indiscriminately and the number and condition of faecal pellets can indicate the numerical strength of a population. Pellets are generally scattered along the runways and over feeding areas and when fresh can usually be distinguished from those of other native mammals by size, colour and composition. Those species most likely to cause confusion are *M. fuscus, P. higginsi* and *Antechinus* spp. The faecal pellets of *R. l. velutinus* are generally a uniform elongated oval shape 12 mm. to 15 mm. in length and 4 mm. to 5 mm. in diameter but may be of lesser proportions if of sub-adults. They vary from grey to brown in colour and are of a coarse composition. Faeces of *M. fuscus* are easily separable on colour as they are a bright green, those of *P. higginsi* differ in being composed of more finely comminuted material, and those of *Antechinus* spp. are characteristically composed of insect remains.

BREEDING

In the wild

Young males do not usually show any scrotal development until early spring and the approach of the breeding season. During the non-breeding period in winter testes are carried inguinally and range mostly from 6 x 4 mm. to 15 x 9 mm. depending on the rat's age. From August the testes drop into the scrotum which becomes large and conspicuous. They may then measure up to 25 x 15 mm. Testes contraction and retraction take place after the breeding season.

Young may be produced from October to February and both pregnant and lactating females have been trapped over this period. Populations in the colder highland habitats do not generally commence breeding as early as those in the warmer coastal areas. Litter size has been found to range from three to six and the embryos may develop in both horns of the uterus in any numerical order (see table 4). More than one litter may be produced annually, and copulation may occur soon after parturition, as shown by captive studies.

Nipples are difficult to discern in the sub-adults but can be easily located after August with the approach of breeding. Nipple distension, as a result of suckling, is not obvious in early lactation but in the later stage it is apparent and nipples may be manually stretched to 8 mm. With care, milk can be expressed with the fingers. Fur loss, from the vicinity of the nipples, is usually slight but may increase with succeeding litters and become noticable towards the end of the breeding season.

In captivity

Attempts to breed *R. l. velutinus* in captivity in 1963-4 and 1964-5 were without success. The paired rats had been housed in wire fronted tin cages measuring 18 inches long by 10 inches deep and 12 inches high. Each cage was equipped with an exterior nesting compartment measuring 6 x 5 x 5 inches. The floors of the cage were liberally lined with saw dust and dry straw was provided for nesting material. A variety of food items including fruit, green vegetable leaves or lawn clippings, and commercial dog cubes was always available.

Nests were formed by the rats shredding the dry straw into fine strands and packing it in the nest boxes to form a dense lining and leaving just sufficient space for occupation.

A number of wild-caught unassociated individuals were paired under these conditions in the spring of 1963, and in 1964 the attempt was again repeated with the addition of a pair reasonably assumed to have been paired in their wild state. Attempted copulation was noticed on one evening but no young were produced.

In February 1965, while collecting in the Waratah area, eleven adult females were collected alive, indivually housed in the cages described, and taken home for breeding studies. Of the adult females killed and processed on this collecting trip about 60% were pregnant and it was considered reasonable to assume that about half the live sample would be in a similar condition. After five weeks in captivity, during which time none had been found to produce young and no abdominal distension was noticable, the sample was killed and processed. None of the rats were found to be pregnant but small scar-like marks were noticeable in most uteri. It was then assumed that resorption of the embryos had taken place as a result of shock, caused by the sudden environmental change.

On 8.XI.1965 a sample was collected from the Great Western Tier. One female, reasonably assumed by palpation to be pregnant, and a pair trapped from a

TABLE 4. Analysis of eleven sets of embryos from wild-caught *R. l. velutinus*.

Date	No. of Embryo	Uterine Horn	
		Left	Right
13.X.1963	4	?	?
23.II.1964	4	1	3
24.II.1964	4	1	3
8.II.1965	5	1	4
8.II.1965	6	2	4
11.II.1965	3	2	1
11.II.1965	3	1	2
9.XI.1965	3	2	1
19.XI.1965	5	5	0
6.XII.1965	4	3	1
6.XII.1965	4	1	3

common burrow, were retained for further cage breeding attempts. The single female was housed as previously described and after eight days in captivity showed no further abdominal distension, nor could any indication of embryos be felt by palpation. She was then killed and processed and was found to contain two almost resorbed embryos, one in each uterine horn, appearing as dark lumps about 4 x 2 mm. each. The uterus was preserved and added to the Queen Victoria Museum collections (Reg. No. 1965:1:256).

The remaining pair was housed in a larger cage measuring 8 feet long by 30 inches deep and 30 inches high. On one end was a closed-in wooden box measuring 18 x 10 x 12 inches inside which was a smaller nest box measuring 6 x 5 x 5 inches internally. Dry straw was provided for nesting material and on the first night of housing the rats lined and occupied the small nest box. Though no abdominal distension was noticeable pregnancy was suspected as other females taken on the same collecting trip were found to be pregnant. Periodic inspections of the nest box were made. It was invariably found to be occupied by both rats during the day time and at night they shyly entered the cage area to feed, drink, and exercise. If disturbed during these excursions they hurriedly retreated to the shelter of the nest. Very little attempt was made to escape by gnawing.

At 0800 hours on 18.XI.1965 faint squeaks could be heard coming from the nest box and upon examination the female flushed from the nest which was then found to contain four newly born young. The male was hiding beneath straw near the nest. Though timid the female made several attempts to re-enter the nest box before retiring to the other end of the cage. One young was then removed and taken away for examination and five minutes later when the nest box was again examined the remaining three young were found dead on the floor outside the entrance to the nest. Each had been bitten about the head and thoracic region and one had the top of the head and brains removed (see plate 6). The male was discovered inside the nest box in a highly excited condition and was apparently responsible for the havoc. The female still remained at the other end of the cage.

The male was then removed from the cage and placed in alternate housing. The remaining young was returned to the nest and the female quietly roused till she re-entered the nest. When examined half an hour later both animals were found resting quietly in the nest. On 24.XII.1965, at 35 days, the young was found to have abandoned the nest and was living in a hole formed in accumulated rubbish beneath the nest box. It had apparently formed the hole itself as there was not sufficient room to allow the female to enter.

On the 23.I.1966 the young was found in an advanced state of decomposition, the cause of death unknown. Its estimated life was 60 days. The male was then returned to the cage with the female but did not readily associate with her. Subsequent inspections were usually carried out when the rats fed and the male was rarely found in the nest box with the female. He had enlarged the chamber beneath the box and usually rested there.

About this time the rats gnawed several holes through the wooden walls of their cage and thus gained access to the main housing area which was a cage 15 feet long by 12 feet deep by 6 feet high. They were left undisturbed and shared the extended range with a family of *P. higginsi*. Much additional straw and litter was collected by the rats and carried to the nest box until it became completely covered and tunnels were formed in the accumulation.

On 7.III.1966 the female was found to have a second litter in the same nest. It consisted of three males and one female and based on growth and development rates of other litters (see later) the young were estimated to be between 9 and 12 days old. One male, Reg. No. 1966:1:18 was removed and preserved in 70% alcohol. This was 43 days after the adult male was presented to the female and gives and estimated gestation period of less than 31 days.

The 3 remaining young developed normally and by 26.III.1966, 2 had abandoned the nest. The following morning all 3 were missing and the nest was found to contain 5 newly born young.

On 3.IV.1966 one juvenile male was removed and preserved in 70% alcohol. (Reg. No. 1966:1:19). The remaining 4 were reared and abandoned the nest about 18.IV.1966 to live in the cavity beneath the nest box. Soon afterwards the nest box was found to have been completely cleaned out and left bare. Adjacent accumulated rubbish was also reduced and scattered some three feet away from the nest site. This activity destroyed the tunnels round the nest box and the newly weaned young of the third litter were found to have dispersed to other sleeping quarters, often in association with the second litter.

On 6.V.1966 the old female was found to have just produced a fourth litter of three in a new nest site. On this occasion it was in a nest box attached to a cage 5 feet above the ground which had up to that time been used as sleeping quarters by the family of *P. higginsi*. These were found to have moved to new quarters and the nest had been completely renovated with the addition of much new material. All three of the fourth litter were reared and abandoned the nest on 28.V.1966.

On 6.VII.1966 a nest containing a litter of four males, estimated to be about six or seven days old, was found in a nest box about four feet above the ground. The old female was present but quickly flushed when disturbed. The following morning the nest was found disarranged and the young discarded and partly eaten.

The breeding area was not examined again until 6.X.1966 when it was found that a litter of 3 estimated to be about 38 days of age, were present and had already abandoned their maternal nest.

On 9.X.1966 a nest of 4 young was found and these were estimated to be about 12 days old. On this occasion the parent female was found in the nest with the young and a male was in an associated nest built along side but partitioned from the maternal nest. As no other rats were in the immediate vicinity it was assumed that this male was the female's established mate and both were removed, together with the young, to a small tin cage (previously described) and kept indoors for closer observations. Upon examination the male was found to be a young of the third litter, born on 27.III.1966. It appeared to be in full breeding condition and had a body weight of 140 gm. All continued to live harmoniously in the confined space, the male often sharing the maternal nest. The four young were weaned and removed from the cage on 5.XI.1966 and the adult pair retained for further observations. The female was always alert and timid. The male was more sluggish and was often found asleep lying curled up on its side in the nest. It was, however, more spiteful than the female and would bite one's hand at every opportunity.

The original male and presumed sire of the first six litters appeared to be in a post breeding decline and was found dead on 18.XII.1966. Details of the litters are tabulated in table 5.

Throughout this breeding period the old male was never found to associate with the female or progeny in the nest. It alternated its choice of diurnal resting quarters between several sites but usually chose elevated positions up to 6 feet high. Access to these was gained by climbing the wire netting sides of the main housing area.

Both the adult males and the female appeared in a healthy condition throughout the breeding season but the female was usually more active.

TABLE 5. Nest periods of 7 litters of *R. l. velutinus.*

Litter No.	Date of Birth	Number in litter	Nest Abandonment
1	18.XI.1965	4	24.XII.1965
2	23-26.II.1966	4	26.III.1966
3	27.III.1966	5	18.IV.1966
4	6.V.1966	3	30.V.1966
5	29-30.VI.1966	4	Killed 7.VII.1966
6	28.VIII.1966	3	before 6.X.1966
7	28.IX.1966	4	5.XI.1966

DESCRIPTION, GROWTH AND DEVELOPMENT OF YOUNG

Description of newly born young

Newly born *R. l. velutinus* (see plate 6) are naked with a loose semi-transparent pink skin through which can be seen the outline of the ribs and intestines. The eyes are closed and appear only as dark marks. The ears are closed with the terminal half turned down and adhering firmly to the basal region so as to completely seal the aperture. The mouth is well formed and radiates 4 mm. from mid lip. No teeth have erupted and the gums are soft and jelly-like. The nostrils appear as small pin holes 2 mm. apart. Front and back feet are evenly developed with the claws erupted to 0.3 mm. and the pads well formed. The tail is proportionally short, being only about twice the pes length and with no signs of scalation. The facial region is robust with a swollen appearance and a few hairs, visible only by magnification, are present on the lips and chin. Vibrissae are erupting with mystacials to 1.5 mm. and supraorbitals and genals to 1 mm. The weight and measurements of the three young illustrated in plate 7 are given in table 6.

When newly born they are slow of movement and possess little control of their position in the nest. Vocal powers are feeble but are exercised when the young are disturbed by the movements of the parent. Sex is determinable by a slight grey pigmentation of the skin in the scrotal region of males. This pigmentation is lacking in the females. Finlayson (1960) found the males of *Rattus greyi* recognisable by this feature at 12 days old. Taylor (1961) found the same feature recognisable in *R. assimilis* at 2 days old.

Growth and development

The progressive growth and development has been found to vary considerably between litters, some developing much faster than others. Following weaning, the males of the litter usually developed more rapidly than did the females.

Growth and development of the only surviving young of the first litter was very slow and at the time of its death at about 60 days it had attained a body weight of only about a third and a total length of about half of that of subsequent litters at the same age. This was, in part, due to the loss of its left front leg from an unknown cause at about 15 days of age. However, development was slow from the time of birth and this may have been due to poor lactation consequent on the lack of stimulus provided by the single young. In the subsequent litters it was found that the numerically largest litters grew and developed at the fastest rate. But for a slight slackening at about 25 days, or about weaning time, the rate of growth and development established during the suckling period was carried through to near maturity. The growth and development of the three normal litters was fairly constant, but there was some variation.

TABLE 6. Weights (gm.) and length (mm.) of three of the first litter of *R. l. velutinus* at less than one day old.

	♂	♂	♀
Weight	4.89	5.34	4.14
Total length	63	65	64
Tail length	14	14	14
Head length	18	18	BROKEN
Pes length	8	8.5	7.5

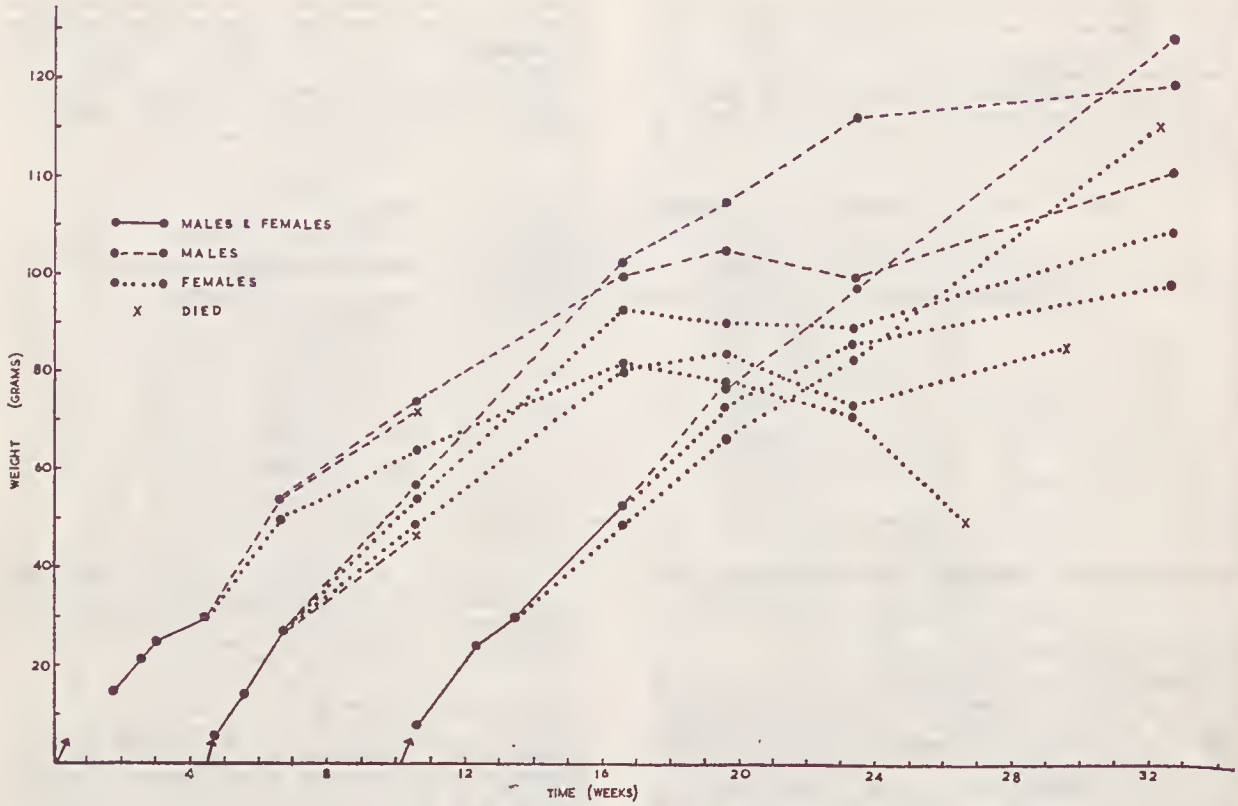

Figure 4. Weight gain in three litters of *R. l. velutinus.*

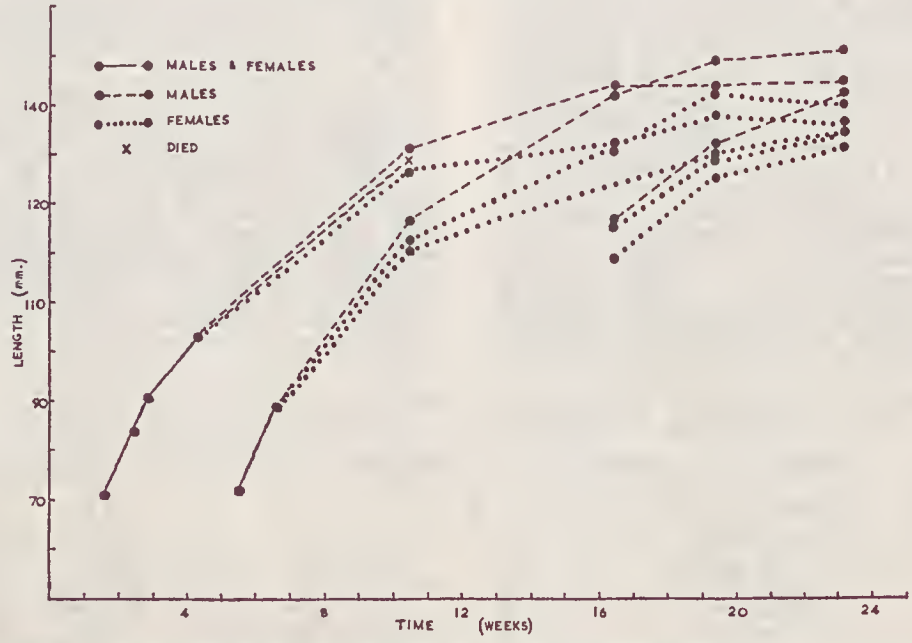

Figure 5. Growth rate of the head and body in the three surviving litters of *R. l. velutinus.*

Weights and body lengths are shown in figures 4 and 5.

A female of the fourth litter was accidentally killed on 6.X.1966 when 154 days old. Upon dissection she was found to be carrying 3 partly developed embryos in the left uterus. Her pregnant condition no doubt was responsible for the rapid weight gain illustrated in figure 4.

At 3 days the young appeared noticeably fatter than at birth and their skin had lost its loose, wrinkled appearance. The dorsum had become greyish.

At 7 days they were still sleepy and listless but would readily squeak if handled. The milk-filled intestines were still visible through the abdominal skin. The eyes remained closed but the lids were clearly formed. In one individual the ears opened and the terminal half became erect but in most cases this development took place several days later.

Pelage had erupted all over the body and was clearly visible to the naked eye as a fine fuzz, though less so on the ventrum. On the dorsal surface it was black, the body fur reached to 0.3 mm. and the guard hairs to 1 mm. The dorsal skin was grey and the ventral skin and erupting pelage white.

The skin of the tail was grey except for the extreme tip which was still white. The tail scales were clearly visible, the central hair of each scale being black and reaching to 0.5 mm. on the basal half but becoming progressively shorter terminally.

The dorsal skin on the feet was grey with black hairs just erupting. The soles of the feet were pale grey to white, the manus being paler than the pes. A few vibrassae were present and reached to 2 mm.

The region of the lips and nose was still relatively large. Five rows of white mystacial vibrassae were clearly visible, the posterior being longest and reaching to 9 mm.

At 12 days (see plate 7) the young were active, crawled confidently and would quickly regain their feet if placed on their back. They readily nuzzled into holes such as the half closed fist and having found seclusion would rest quietly in any position.

Dorsal fur reached to 2 mm. with the guard hairs to 4 mm. and mystacial vibrissae to 12 mm. The incisor teeth were clearly visible through the gums, the lower pair being slightly more prominent. The ears were still thick and lacked controlled movement. Odd fleas and mites were present in the short pelage and the young rats occasionally scratched their head, neck and scapular region with the hind foot.

At 16 days they responded to noise and would endeavour to escape when handled. After handling they were often seen to "wash" the facial regions with the front paws. The ears were well developed and actively used as were the nose and mystacial vibrissae. On the mid dorsal region the body fur reached to 4 mm. with the guard hairs to 5 mm. The ventral pelage was somewhat shorter and had developed to a pale grey. The mystacial vibrissae reached to 18 mm. and the eyes were opening. The incisor teeth were clearing the gums and had a yellow facing but the extreme tips were white. Finlayson (1960) found the suckling young of *R. greyi* to have their incisor teeth also tipped white.

At 22 days they were very alert and active and would explode from the nest when disturbed. From about this age they abandoned the maternal nest and lived by day in any nearby hole or nest box which was available, often in company with others of previous litters. They would bite when handled but were hardly strong enough to break the skin of the hand. The white tips had worn from the incisors. Pelage was adult-like in appearance with the body fur on the mid dorsal region reaching to 10 mm. and the guard hairs to 17 mm. Mystacial vibrissae reached to 30 mm. The vaginas of the females were open.

From about this age they appeared to be weaned onto a solid diet and to live an independent life. Except for their smaller size they were adult in appearance.

TRAPPING AND FIELD STUDIES

Trapping

The common household snap trap was used as the principal means of collecting when rats were wanted for dissection or processing. When collecting for live studies 9 x 3 x 3 inches Sherman box traps were used. These had been made from galvanised flat iron and were more robust than the standard aluminium type which can be chewed and distorted by the rats (Pers. comm. B. E. Horner).

A variety of baits was used including rolled oats, peanut butter, honey, raisins and chopped bacon mixed in various proportions. Apple, cheese, bacon, raisins, raw meat, plain bread and bread scented with vanilla essence were used individually. Catches were made on all kinds of bait but no marked preference was shown for any one. Consequently plain bread cut in three quarter inch cubes was used for preference because of the convenience of handling and the absence of messiness often resulting from the use of other baits.

Skull damage caused by snap traps occurred in about 10% of catches. Predation on trapped rats was rare, and in the few instances damage was confined to the thoracic region and of such a nature as might be expected from *Antechinus* spp.

No interference was encountered from Quolls *Dasyurus viverrinus* as was experienced by Finlayson (1933), even in areas near to Cradle Mountain where he found it necessary to remove the local Quolls before being able to collect rats satisfactorily.

Traps were generally set at intervals of ten to twenty yards depending on the indications of relative abundance. Preferred sites were on runways but many catches were made beneath logs, bush and general foliage. A total of 245 *R. l. velutinus* has been captured in about 4,000 trap nights. An additional 1,700 trap nights for tagging and release studies has resulted in 45 original captures and 150 recaptures. During these operations the total catch of other species of murids and phascogales, almost equalled that of *R. l. velutinus*. Under normal trapping conditions it was found that over half the resident population could be collected in the first 24 hours. When animals were being removed, sets were usually limited to this period; not only to enhance the trapping results but also as a safeguard against local extermination.

Trap checking carried out at different times of the day and night has shown that *R. l. velutinus* is diurnally active. Traps set out before mid-day have often produced an evening catch about equal to that of the following morning. On several occasions while setting out traps during the day, a trap just set has been heard to fire and upon examination found to contain a rat. In areas with reasonably high populations, with traps set at 10 yard intervals, a 24 hour catch of better than 10% would be expected throughout most of the year. During the earlier months of the breeding season, when populations are at their lowest numerical strength, the catch is usually somewhat less.

Field studies

The first field studies were started at Greens Beach in January, 1964. The area selected was a natural

depression about 250 yards by 70 yards densely vegetated with tea-tree and heath ranging from a foot to six feet high. In the winter months, following heavy rains, the lowest lying parts usually became waterlogged and carried surface water to a depth of one to two inches. During the summer the whole area dried out and no free water was available within half a mile. Within the area runways were numerous and well formed but became less conspicuous towards the edges where the vegetation was not so dense. Other patches of similar habitat occurred nearby.

Forty Sherman traps were set throughout the study area in an elongated oval pattern and placed at intervals of 10 to 15 yards. Where possible, runways or other such likely sites were chosen. Sets were numbered and on each subsequent retrap the same sites were set. Trapping was conducted at irregular intervals when time permitted over a two year period. Traps were usually down for 48 hours at a time and were checked every 12 hours.

Rats were individually marked with numbered fingerling fish tags clipped into the posterior edge of the ear. A record was kept of location, body weight, breeding conditions, moult, and the obvious ectoparasites.

Between 4.I.1964 and 18.IV.1965, which included the greater part of two breeding seasons, 27 rats (13 ♀♀ and 14 ♂♂) were tagged and released. Trapping continued to 31.I.1966, and 19 rats (12 ♀♀ and 7 ♂♂) were recovered 74 times (see table 7). The recovery rate of females exceeded that of males by about three to one. The scope of the study was too limited to draw conclusions but it appears that a considerable population turnover takes place during the non-breeding winter months.

Many of the young of the year were not retrapped after becoming about half grown and it is assumed that they died from natural causes or emigrated out of the study area. Because of their breeding capabilities, as demonstrated by a captive pair, a fairly high mortality rate may be expected, but nomadic movement also occurs. Two young males, numbers 441 and 442 (see table 7) were originally captured and tagged on 15.VI.1964 on the edge of a swamp half a mile distant from the study area. The intervening vegetation was typical of the area but only patches were suitable for permanent occupation. On 30.VIII.1964, eleven weeks after tagging, no. 441 was recaptured in the study area. It had gained in weight from 103 gm. to 142 gm. but was not taken again. On 8.III.1965, nine months after tagging, no. 442 was recaptured in the study area. It had gained in weight from 70 gm. to 122 gm., had enlarged testes and was apparently in breeding condition.

TABLE 7. Trapping history of *R. l. velutinus* tagged in the study area.

Tag Number	Sex	Initial Weight	First Caught	Times Retrapped	Last Caught
401	♀	134	4.I.1964	5	29.III.1964
402	♀	45	25.I.1964	9	14.VI.1964
417	♀	75	9.II.1964	6	14.VI.1964
418	♀	74	15.II.1964	7	30.III.1964
419	♂	77	15.II.1964	0	15.II.1964
431	♂	90	28.III.1964	6	30.VIII.1964
432	♀	80	28.III.1964	1	29.III.1964
433	♀	95	28.III.1964	2	29.VIII.1964
434	♀	36	29.III.1964	6	31.VIII.1964
435	♂	96	29.III.1964	3	14.VI.1964
436	♀	64	29.III.1964	2	30.III.1964
437	♂	84	30.III.1964	1	30.III.1964
439	♂	100	13.VI.1964	3	31.VIII.1964
440	♂	?	30.III.1964	1	14.VI.1964
441	♂	103	30.VIII.1964	0	30.VIII.1964
442	♂	70	8.III.1965	4	20.XI.1965
452	♀	115	30.VIII.1964	8	31.I.1966
453	♂	130	30.VIII.1964	0	30.VIII.1964
459	♂	128	20.XI.1964	0	20.XI.1964
460	♂	124	20.XI.1964	0	20.XI.1964
461	♀	86	20.XI.1964	0	20.XI.1964
464	♀	107	11.I.1965	6	19.IV.1965
467	♂	96	7.III.1965	0	7.III.1965
468	♀	75	8.III.1965	1	31.X.1965
469	♀	53	17.IV.1965	2	19.IV.1965
472	♂	50	17.IV.1965	0	17.IV.1965
475	♂	55	18.IV.1965	1	19.IV.1965

It was subsequently recaptured in the same locality on four more occasions, the last being on 20.XI.1965.

Breeding pairs were found to remain within a home range of about 50 yards radius and their off-spring stayed within or near this range, on some occasions for up to eight months after weaning. By spring time and the commencement of a new breeding season, family groups had dispersed and the area was again restricted to a breeding pair.

The study area included two such ranges and these were reoccupied by succeeding generations.

In the northern end no. 401 was trapped in the first summer and appeared to breed successfully. She was last trapped in a weak condition on 29.III.1964, and on 30.VIII.1964 a new female, no. 452 had occupied the same range. The new occupant appeared to remain for at least 17 months as she was retrapped on eight subsequent occasions, always within this range, the last time being on 30.I.1966 when she was found to be heavily lactating, for her second breeding season.

No adult male was found associated with 401 but following her disappearance, two young males, nos. 439 and 442 moved into the area. The former was trapped there on four occasions from June to August after which it was not found again. The latter was trapped six times, the last being on 20.XI.1965. He apparently remained for two breeding seasons and paired with 452.

In the southern end only sub-adults were trapped in the first summer, their parents having apparently died just prior to the commencement of the study. In the following summer the territory was occupied by female no. 464 which was trapped on 7 occasions between January and April. During this time the condition of her nipples indicated that she was breeding successfully. No adult males were taken within this territory over this period but earlier in the season two adult males, no. 459 and 460, were taken. The former was in breeding condition but the latter lacked testes development.

A parallel study was commenced in a highland area near Cradle Mountain in December, 1965. Results to date indicate a similar home range and disperal of young and this will be discussed further in a later publication.

MISCELLANEOUS OBSERVATIONS

Keeping in captivity

R. l. velutinus is hardy and easily kept in captivity. When very young (soon after weaning) it has a docile disposition and is easily handled even when wild-caught, but as it develops it becomes timid, spiteful, and difficult to handle, whether wild-caught or cage-bred. Adults, when newly taken from the wild, will gnaw vigorously for the first few hours in an endeavour to escape, but if unsuccessful will soon desist and settle to their new environment.

Strangers will fight each other in a frightened, defensive attitude when first placed together in a confined area. Offensive behaviour to others of their own kind is unusual under these conditions and strangers soon settle down permitting a number to be kept together.

They will readily build nests out of almost any available material. Bagging, straw, etc. is shredded into finer particles and packed into the chosen site. Inside this the rats form a spherical chamber and after entry will usually block the opening with nesting material. Similarly, entrances are often blocked up with litter from the outside when rats vacate the nest.

The fur is regularly tended by the rats licking and scratching themselves and rubbing the facial regions with the inner edges of the front paws. Scratching is undertaken with the hind feet following which the toe nails are cleaned with the teeth.

They will feed on a wide variety of foods including most household scraps but the principal diet used in this study has been plain bread, commercial dog cubes and lawn clippings. Items are sometimes carried into a nest or similar secluded place before being eaten. Water is taken freely when available but the rats can survive for extended periods on the moisture obtained from succulent vegetable foods. A number of rats were kept experimentally, without access to free water from June to the end of December, 1965. Over this period their diet always included some fruit or vegetable items such as apples, green vegetable leaves or lawn clippings. No deterioration in appearance or loss of body weight was noticed until the moist foods were removed from their diet in early January. As a result of a dry diet of bread and dog cubes there was a rapid decline in body weight, followed by loss of bodily control. The rats would run round as if in a stupor but usually regained normality within a few days of being given access to free water.

Parasites

Ectoparasites have been collected from rats whenever opportunity permitted and have been lodged with the National Insect Collection in Canberra. Some more recently collected material still awaits determination but table 8 gives details of the earlier samples together with some additional material collected by Messrs. B. C. Mollison and T. Andersen.

Rats collected at Greens Beach from coastal swampland habitat were found to be more heavily affected by ticks than those in other habitats. In December and January it was not unusual to find rats from that locality with dense clusters of ticks adhering to the skin of the ventrum. After January the infestation decreased, leaving sores which often resulted in naked scars. In one instance, a cluster round a thoracic nipple caused damage which resulted in the loss of the nipple. Severe tick infestation was not noted in other habitat nor was it in evidence in the Greens Beach area outside the summer months.

A small series of *R. l. velutinus* collected from rain forest habitat in the Great Western Tiers in November 1965 was found to have nematodes to 4 mm. long in the stomachs. These still await determination. Odd individuals in a series collected from north-west rain forests in February 1965 were found to have livers badly distorted with watery cysts containing the bladder-worm stage of a cestode, *Cysticercus fasciolaris* (Munday 1966).

The brains of 22 *R. l. velutinus* were sent to the Department of Agriculture for inclusion in a survey of *Toxoplasmosis* in Tasmania. One of these proved positive (Munday 1966). The lungs of 16 *R. l. velutinus* were examined by the same authority for *Emmonsia crescens* with negative results. However, two had a few small granulomata containing bacteria (not isolated) and chronic peribronchiolitis (unidentified *Corynebacterium* sp. isolated) (Munday 1966). One *R. l. velutinus* was examined for *Leptospires* in kidney and liver sections and sera from five was tested for antibodies against *Leptospira canicola, Icterohaemorrhagiae, Pomana* and *Hyos* by the above authority, all with negative results (Munday 1966).

TABLE 8. Ectoparasites collected from *R. l. velutinus*

ACARINA

TICKS (determined by Dr. F. H. S. Roberts)

Ixodes trichosuri Flowery Gully (larvae) 3.IV.1963

I. tasmani Yolla (nymphs and larvae) 16.II.1962; Cradle Mtn. (ll.) 27.IV.1963.

I. cornuatus Hunting Ground (nn.) Nov. 1963.

I. sp.? *cornuatus* Greens Beach (ll.) 19-28.II.1961, (ll.) 11-12.V.1963; (ll.) Kelso 19-28.II.1961.

MITES (determined by Mr. R. Domrow)

Laelaps assimilis Cradle Mtn., Nov. 1938, Nov. 1939; Mt. Wellington; Kelso, 1961; Maydena, 1961; Tonganah, 20.V.1961; Yolla, 16.II.1962; Maria Is., 21.IV.1962; Peak Plains, Burnie, 16.VII.1962; St. Valentines Peak, 13.VII.1962, 20.IX.1962; Erriba, 20.III.1963; Greens Beach, 14.X.1963; Laboratory Colony, Launceston, 12.I.1964.

Masolaelaps bandicoota Tonganah, 20.V.1961; Greens Beach, 14.X.1963.

M. sp. Kelso, 1961; Maydena, 1961.

Laelapsella humi Cradle Mtn., Nov. 1938; Mt. Wellington; Greens Beach, 10.V.1961, 11-19.V.1963, 4.X.1963; Tonganah, 20.V.1961; Yolla, 16.II.1962; Maria Is., 21.IV.1962

Listrophoroides expansus Cradle Mtn., Nov. 1938, Nov. 1939; Yolla, 16.II.1962; Maria Is., 21.IV.1962.

INSECTA

FLEAS (determined by Dr. G. M. Dunnet)

Pygiopsylla hoplia Kelso, 19.II.1961; Greens Beach, 10.V.1961, 12.V.1963; Peak Plains, Burnie, 16.VII.1962; Erriba, 20.III.1963; Cradle Mtn., 27.IV.1963; Waratah, 5-7.VI.1963.

P. zethi Kelso, 19.II.1961; Greens Beach, 27.II.1961.

P. rainbowi Greens Beach, 12.V.1963.

P. sp. Kelso, 19.II.1961; Greens Beach, 18-25.IV.1961, 10.V.1961.

Acanthopsylla rothschildi Yolla, 16.II.1962.

Stephanocircus pectinipes Waratah, 5-7.VI.1961.

S. dasyuri Greens Beach, 12.V.1963.

S. simsoni Waratah, 5-7.VI.1963.

S. sp. St. Valentines Peak, 16.VII.1962; Cradle Mtn., 22.VI.1964.

Macropsylla hercules Greens Beach, 27.II.1961, 18-25.IV.1961, 19.IV.1962, 12.V.1963; Maria Island, 21.IV.1962; Waratah, 5-7.VI.1963; Binalong Bay, 16.IX.1963.

Leptopsylla segnis Greens Beach, 18-25.IV.1961, Yolla, 16.II.1962.

LICE (determined by Dr. Theresa Clay)

Polyplax spinulosa Kelso, 28.II.1961; Greens Beach, 25.IV.1961; Maydena, 7.XII.1961; Maria Is., 21.IV.1962

Hoplopleura n. sp. Erriba, 20.III.1963; Cradle Mtn., 27.IV.1963

BEETLES (Staphylinidae) (determined by Dr. C. Seevers)

Myotyphlus jansomi St. Patricks River; Florentine Valley, 7.VII.1959; Maydena, 7.XII.1961; St. Valentines Peak, 12.VII.1962

Natural enemies

No evidence has been found to suggest that any single predator species exercises a major control over *R. l. velutinus* but no doubt a number of species play a part in removing surplus animals. The Masked Owl *Tyto castanops* would undoubtedly be a nocturnal predator in some areas and many of the hawks would be diurnal predators but these birds do not occur in sufficient numbers to be a major hazard.

The Quoll *D. viverrinus* occurs in many places where *R. l. velutinus* is found and it would be expected to be an efficient predator. While trapping in open country near Cradle Mountain in June, 1966 a three inch overnight snowfall resulted in a good display of animal tracks. The nocturnal activity of the Quolls in rat habitat was evident by the prevalence of their footprints in the snow. Sherman traps were being used at the time and in several instances Quoll imprints were found on top of the traps. Despite the prevalence of Quolls in the area, interference to the traps was negligible. Though predation appears obvious the high population of *R. l. velutinus* and associated small mammals indicates that it is not excessive.

The runways are similarly used by *M. fuscus, A. minimus* and *A. swainsonii*, the latter being almost as numerous in some areas as *R. l. velutinus*. Cage studies have shown that *A. swainsonii* will quickly kill and feed on small birds and the European house mouse *M. musculus* (unpublished data) and it is probable that they take some juvenile rats. The feral cat is uncommon in the rain forest and sedgeland habitats and its abundance in the coastal swampland is low.

Natural predators therefore appear to be assisting in maintaining a healthy balance, and Finlayson's (1933) findings of a strong rat population associated with a prevalence of *D. viverrinus* supports this assumption.

The temporary destruction of habitat by fire is the most important factor controlling the population and distribution of *R. l. velutinus*. The present stronghold of this rat is principally in the undeveloped areas in the western half of the island. Because of the isolation and comparative unimportance of much of the area for primary production, particularly in the open sedgeland, summer fires may be left to burn out and as a consequence many thousands of acres of habitat may be destroyed. Regrowth is slow and it may take from five to ten years before the vegetation reaches sufficient density to support good numbers of murids and other small mammals. As the fire risk increases with the regrowth and vegetational density, so some of the oldest and numerically strongest rat populations are often the most susceptible to sudden destruction.

In some sedgeland areas cattle are grazed during the summer months and the lessees of such areas often endeavour to keep overgrowth burnt back to provide for more succulent cattle feed in the form of regrowth. Wet swampy areas are often more resistant to fires but because of their nearness to water and greener summer growth they are more attractive for cattle grazing and cattle "camps". Good habitation can be destroyed by the direct action of concentrated "cattle padding".

Though the potential population of *R. l. velutinus* is checked to some extent by these factors its distribution remains extensive and it is numerically strong. Its ability to thrive in such diversified habitats has undoubtedly contributed to its present strength and I see no reason why it should not continue to be a common mammal wherever its habitat is suitable.

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No. 29

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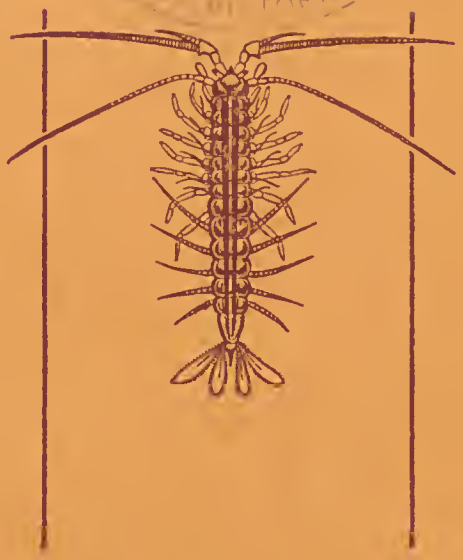

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CERTAIN NOMENCLATURAL PROPOSALS IN GALAXIIDAE: A REJOINDER

by

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SUMMARY

In a recent paper (Stokell, 1966) the hitherto universally accepted trivial name *truttaceus* is discarded and replaced by *scopus; Galaxias attenuatus* (Jenyns) and *G. alpinus* (Jenyns) are relegated to the synonymy of *G. maculatus* (Jenyns); a new subspecific name, *ignotus*, is proposed for the Tasmanian and mainland Australian subspecies of the fish hitherto known as *G. attenuatus;* the specific distinctness of *G. auratus* Johnston and *G. weedoni* Johnston is called in question. The present paper sets out a case against these nomenclatural innovations.

0. INTRODUCTION

0.0. The proposals. — In a recent paper, *A Preliminary Investigation of the Systematics of Some Tasmanian Galaxiidae* (Stokell, 1966) certain proposals involving nomenclatural change are made: *(a)* the trivial name, *truttaceus*, of the fish that has hitherto been recognised as the genotype of *Galaxias* Cuvier, 1816 is rejected, the species now being called *G. scopus* Scott, 1936 [date cited, in error, as 1935]; *(b) Galaxias attenuatus* (Jenyns, 1842) and *G. alpinus* (Jenyns, 1842) are stated to be synonymic with *G. maculatus* (Jenyns, 1842), by which last name (which enjoys page priority) all three thus now become known; *(c)* a Tasmanian (and mainland Australian) subspecies of the species known up till now as *G. attenuatus* is described under the new name of *G. maculatus ignotus* Stokell, 1966; *(d)* Of *G. auratus* Johnston, 1883 and *G. weedoni* Johnston, 1883 it is observed 'it seems questionable if these two nominal species are distinct.'

0.1. Rejoinder. — The present paper advances the following views: *(a)* the name *Galaxias truttaceus* (Cuvier, 1816) should be retained; *(b)* the suggested identity of Jenyns' three species stands unproven, and, on the information at present available, they should continue to be treated as distinct; *(c)* the Tasmanian and mainland subspecies of the species hitherto known as *G. attenuatus*, if valid, should be known as *G. attenuatus scriba* Cuvier & Valenciennes, 1846; *(d)* Johnston's two species are quite distinct.

0.11. While the interest attached to two of these nomenclatural proposals — *(c)*, *(d)* — is in large measure restricted to taxonomists more or less directly engaged with the systematics of the family and to students of the local fauna, the case is far otherwise with *(a)* and *(b)*. Both the first of these, involving as it does the introduction, after a century and a half, of a new trivial name for the species hitherto accepted as the genotype of *Galaxias* Cuvier, 1816, the foundation genus of Galaxiidae, and the second, necessitating the use of a name other than that till now employed for the one widely distributed Galaxiid, clearly have potential repercussions extending far beyond the field of the Tasmanian fauna, any general discussion of the Galaxiidae—purely systematic, zoogeographical, ecological, or otherwise — almost inevitably entailing some reference by name to one or both of these species.

I. PROPOSED DISCARDING OF THE TRIVIAL NAME *truttaceus* and ITS REPLACEMENT BY *scopus*

1.0. The proposal. — 'The application of the name *truttaceus* to the Tasmanian fish appears to be a misidentification of a type species and a new name or the reinstatement of a synonym to be necessary' (p. 79). The name adopted is *G. scopus* Scott [in a table of synonymy heading a description of material from the 'lower Tamar River and its tributaries' the date cited, 1935, is that of the session of the Royal Society in which the relevant paper was submitted: date of publication is 1936].

1.1. The argument. — The discussion of the status of the trivial name *truttaceus* occurs on pp. 78-79.

1.11. Apart from the opening sentence ('The name *truttaceus*, which is universally applied to the common black-spotted [the epithet black-spotted is applicable — and then not very appropriately, the markings being ocelli — only to preserved specimens] species of Tasmania and Victoria, is of very doubtful validity'), the material is of an introductory nature, and is confined to facts well known. The definition by Cuvier of *Galaxias* [1817 cited : it is generally accepted the actual date of publication is 1816] is quoted, together with the original footnote ('(i) *Esox truttaceus* Cuv. espèce nouvelle, ou peut-être L'es. *argenteus* Forst?') and the footnote of later editions ('*Esox truttaceus* Cuv. *Esox alepidotus* Forst'); G. Forster's notice (1777) of the taking by Captain Cook in 1773 at Dusky Bay, New Zealand of the first known Galaxiid is recalled; Gmelin's (1789) latinized description based on Forster's account (but using, on the assumption of identity of the two forms, the name, *Esox argenteus*, proposed by G. Forster for a fish taken from the sea at Tanna Island) is quoted.

1.111. It is convenient at this point to observe that the combination *Galax (ias) truttaceus* appears for the first time in the German edition of Cuvier (1822 : 309), a translation and enlargement of the first edition, in which Cuvier's names are now latinized (Scott, 1936 : 89).

1.12. The first paragraph and the first two sentences of the second paragraph on p. 79 are critical and need to be quoted in full.

1.121. 'In 1801 Bloch and Schneider published J. R. Forster's account of the fishes taken on Captain Cook's voyages, and recorded the yellow-spotted [the markings are perhaps blotches and vermiculations, rather than spots] species from Dusky Bay as *Esox alepidotus*, which was J. R. Forster's manuscript name. These descriptions were published many years before Cuvier defined his genus, and no description of the Tasmanian fish appears to have been published in the interim. The yellow or golden markings recorded on the New Zealand fish constitute the principal evidence of the species on which the genus was founded. Their resemblance to a galaxy suggests the reason for the name *Galaxias*, which cannot be conceived to have been inspired by a contemplation of the black-spotted fish in [in = of ?] Tasmania. Cuvier & Valenciennes (1846), actually Valenciennes who wrote of Cuvier in the third person, asserted that the genus was based on the Tasmanian fish and applied the name *truttaecus* to this species, but made no attempt to explain the name *Galaxias* or Cuvier's alleged ignorance of the New Zealand fish until the Tasmanian one was obtained.'

1.122. 'The application of the name *truttaecus* to the Tasmanian fish appeared to be a misidentification of a type species, and a new name or the reinstatement of a synonym to be necessary.' The species hitherto known as *G. truttaceus* is then formally called *G. scopus* Scott, and an account of ten Tasmanian specimens follows.

1.2. Rejoinder. — It is here contended that the name of the fish (found in Tasmania, on the Australian mainland, and on at least some of the islands of Bass Strait) hitherto spoken of as *G. truttaceus* is that name.

1.21. The sections of Stokell's paper quoted in 1.121, 1.122 above may now be discussed. In Cuvier & Valenciennes' *Histoire naturelle des Poissons* (viii, Paris 1846 — August or September : written by Valenciennes, who speaks of Cuvier in the third person) the circumstances surrounding the establishment of the genus *Galaxias* and the naming of the type species are reported as follows (it seems expedient to give a tolerably free translation : the precise meaning at any point can be checked from the original, here quoted in square brackets).

1.211. The genus Galaxie is one of Cuvier's own formulations; he established it on a small fish, brought back from New Holland by Péron & Lesueur, and which has since been found there again by Quoy & Gaimard. These two royal navy surgeons brought it to our notice that Péron's fish lived in the fresh waters of Van Diemen's Land. ['Le genre Galaxie est une création de M. Cuvier; il l'a établi sur un petit poisson, rapporté de la Nouvelle-Hollande par MM. Péron et Lesueur, et qui y été ensuite retrouvé par MM. Quoy et Gaimard. Ces deux chirugiens de la marine royale nous apprirent que le poisson de Péron vivait dans les eaux douces de la terre de Van-Diemen': p. 340].

1.212. A species of this genus was discovered and thoroughly described by Forster at the time when Captain Cook, during his great circumnavigation, landed, in 1773, on New Zealand. His description, published by Bloch, was recognised only when Cuvier came to determine the fish brought back by Péron. Our noted zoologist named it *Esox truttaceus*, adding that it was perhaps Forster's *Esox argenteus*. He was more definite in the second edition of the *Règne Animal* in distinguishing within the genus Galaxie his *Esox truttaceus* from Forster's *Esox alepidotus*. ['Une espèce de ce genre a été découverte et parfaitment décrite par Forster à l'époque où le capitaine Cook, dans sa grande circumnavigation, abordà, en 1773, à la Nouvelle-Zélande. Sa description, publiée par Bloch, ne fut reconnue qu'à l'époque où M. Cuvier détermina le poisson rapporté par Péron. Notre grand zoologist le nomma *Esox truttaceus*, en ajoutant que c'était peut-être l'*Esox argenteus* de Forster. Il a été plus positif dans la seconde édition du Règne animal, en distinguant dans le genre Galaxie son *Esox truttaceus* de l'*Esox alepidotus* de Forster': pp. 341-2]. (The two footnotes are quoted above in 1.11).

1.213. Valenciennes' account of the Tasmanian species, headed The spotted Galaxie (*Galaxias truttaceus* Cuvier) [*La* Galaxie truitée (*Galaxias truttaceus*, Cuv.], is as follows. If we cannot say that *Galaxias truttaccus* is the first known species of this genus, since Forster had previously observed one of those (species) that stock the fresh waters of New Zealand, we must take it the spotted Galaxie was the first species referred in a definitive fashion to this genus; for it [*i.e.*, the genus] was established on it. Since Péron, Quoy & Gaimard have again found it in Van Diemen's Land. [Si l'on ne peut dire que le *Galaxias truttaceus* soit la première espèce connue de ce genre, puisque déjà Forster avait observé l'une de celles qui peuplent les eaux douces de la Nouvelle-Zélande, on doit regarder que la Galaxie truitée a été la première espèce rapportée d'une manière positive a ce genre; car il été établi d'après elle. Depuis Péron, MM. Quoy et Gaimard l'ont retrouvée à la terre de Van-Diemen': p. 344].

1.214. These three extracts would thus seem to set forth, quite clearly, a simple and unambiguous situation. Cuvier established *Galaxias* on a fish brought from Tasmania by Péron and Lesueur, giving it the trivial name *truttaceus* (= spotted). It was only when he came to determine Péron's fish that the status of Forster's New Zealand fish, of which Bloch had earlier published an account, was recognised; and in the first edition of his book he suggested his fish might perhaps be the same as Forster's, but in the second he listed them as two species. Valenciennes expresses the view that Cuvier's Tasmanian fish is the effective genotype.

1.22. On the passages on p. 79 in Stokell quoted in 1.121, 1.122 the following additional observations may be made.

1.2211. That Valenciennes offers no explanation of the name *Galaxias* is true : indeed, to the best of the present writer's knowledge, there is no authoritative contemporary or early (*i.e.*, up to, say, Valenciennes' time) published explanation. *La galaxie* is certainly the French term for the galaxy or Milky Way : but its connotation here is wholly conjectural. There is indeed no certainty even that it has reference to the markings of the fish — it

may conceivably relate, as has been suggested, to the milky-white color Galaxiids often assume on preservation; it may conceivably have been suggested (as far as Cuvier is concerned by explorers' accounts) by the number and disposition of fish migrating in a ribbon up a river; it may even have no visual connotation at all. However, with Valenciennes chided, it would seem (the tendentious tone of the sentence being set by the gratuitous 'alleged' preceding 'ignorance') for having 'made no attempt to explain the name *Galaxias*,' a New Zealand ichthyologist, writing well over a century later, has been able to establish, to his own satisfaction, first, that 'the yellow or golden markings recorded on the New Zealand fish constitute the principal evidence of the species on which the genus was founded,' and secondly, 'their resemblance to a galaxy suggests the reason for the name *Galaxias*, which cannot be conceived to have been inspired by a contemplation of the black-spotted fish in Tasmania.'

1.22111. On the question of body markings and a generic name possibly suggested by them it may be remarked in passing : *(a)* the New Zealand fish was described by Gmelin (1789 : 1393) as having markings in the form of yellowish letters ('litteris flavicantibus'), Stokell's own version (p. 78) being 'yellowish spots in the shape of some ancient Asiatic characters'; *(b)* 'black-spotted' is not a satisfactory descriptive term for the markings of the Tasmanian fish, the great majority of which take the form of a dark centre (in life commonly greenish or brownish, with or without a purplish cast) surrounded by a light annulus (this distinctive ocellation is indicated clearly in, *e.g.*, the figure by Regan (1906, pl. xiii, fig. 4)), the live fish, incidentally, often sparkling with flashing gold points; *(c)* the relation between observable markings and the name of a a taxon inspired by them is in any case largely a semantic problem, any judgement on which, in such a set-up as the present, is obviously of a highly subjective nature.

1.2212. Just in what way the circumstances that Valenciennes failed to provide the derivation of the generic name *Galaxias* and/or to explain Cuvier's 'alleged ignorance' of the nature of Forster's New Zealand species till he came to describe his own fish can be interpreted as invalidating Valenciennes' definite statements quoted above (2.11) that Cuvier founded his genus on a fish from Tasmania to which he gave the trivial name *truttaccus*, and that Cuvier's species, rather than Forster's earlier described species, should be regarded as the first species referred definitively to this genus, it is indeed not easy to see.

1.2221. It will have been observed that the argument in Stokell's paper has up to now been concerned with the generic name *Galaxias* and its possible origin. The trivial name *truttaccus* itself (which it is proposed should be rejected) has been the subject of no discussion. In this rejoinder the circumstances of its formal introduction have been set out above in the extracts from Valenciennes : the suitability of the application to the 'black-spotted' Tasmanian fish of *truttaccus*, the latinized form of the *truitée* of the French vernacular (La Galaxie truitée : Valenciennes, p. 344) seems evident, and has not been called in question [truité (fem. truitée): 'red-spotted; speckled; spotted (dog, etc); flea-bitten, trout-coloured (horse); mottled (pig-iron); crackled (china)': Harrap (1953 : 865)]. With the first sentence of the second paragraph on p. 79 — 'The application of the name *truttaceus* to the Tasmanian fish appears to be a misidentification of a type species, and a new name or the reinstatement of a synonym to be necessary' — the train of reasoning, however, abruptly takes a fresh turn.

1.2222. The entities significantly involved in the situation are these. Set I. — *A*, a species of spotted fish found in Tasmania; *a*, its trivial name, *truttaceus;* *α*, specimens attributed to this species: Set II. — *B*, a species of fish from New Zealand with yellowish markings; *b*. its trivial name, *alcpidotus* (or *argenteus); β*, specimens attributed to this species: Set III. — *Z*, a fish genus; *z*, its name, *Galaxias;* *ω*, species attributed to this genus ['species', 'genus' here being taken to be defined by their relevant diagnoses]. Sets I and II are commensurable; while their components are formally paralleled by those of Set III. From the passage quoted in 1.121 it would naturally be concluded that the domain of the argument was restricted to Set III, and hence that, since the name *Galaxias* is there claimed to have been inspired by the markings on Forster's species, the New Zealand species would be nominated as genotype, the matter ending there. However, what is now called in question (and, later, categorically rejected) is the validity of the relation between two components of Set I, namely, between *A*, the spotted Tasmanian species, and *a*, its trivial name. Regarding this suggested invalidity of the hitherto universally accepted relation between *A* and *a* no evidence is presented and no discussion is entered into.

1.2223. The rest of the second paragraph on p. 79 is concerned with the choice of a synonym to replace *G. truttaccus*, the name adopted being *G. scopus* Scott, 1936. A description, under this heading, of ten specimens then follows.

1.3. It is not proposed to enter here on a discussion of the true status of the fish from Clarke Island, Bass Strait, for which the name *G. scopus* was originally proposed — this being of course a problem quite other than that of the rejection by Stokell, on the grounds stated and examined above, of Cuvier's name *truttaccus* and its replacement by *scopus*. The name *scopus* may *(a)* be used to denote a species, *Galaxias scopus*, satisfactorily known only from the type material — as originally proposed; or *(b)* be employed as a subspecific name in the trinomial *Galaxias truttaccus scopus* — as by Munro (1957 : 34); or *(c)* be rejected, as a synonym of *Galaxias truttaccus* — as by Frankenberg (1966, pl. on p. 161). The present writer considers it expedient to postpone the expression of a definitive opinion on the matter pending the examination of further topotypical material and its comparison with material from various localities on the Tasmanian mainland and the mainland of Australia. In any event, the word *scopus* should not be used as a substitute for *truttaceus*.

1.4. Type locality. — The adoption of Stokell's proposal would make Clarke Island [rendered Clark by Stokell], near the north-eastern tip of Tasmania — for notes on locality see Scott (1936 : 97) — the type locality for the species hitherto known as *G. truttaceus*. Material from Clarke Island ap-

pears not to have been seen by Stokell, who, however, mentions (p. 79) a specimen from adjacent Flinders Island. The ten examples on which his description is based are from 'the lower Tamar River and its tributaries'; additional localities recorded for the species being Flinders Island and Victoria. [No reference is made at any point to *G. truttaccus hesperius* Whitley, 1944; type locality, Creek flowing into Taylor's Inlet (Nannarup), Albany District, Western Australia]. The inclusion, in error, in the Australian Check-List (McCulloch, 1929 : 48) of New Zealand among the localities from which *G. truttaccus* (Cuvier) has been recorded led the present writer (1936 : 89) to review (largely on bibliographical data obligingly supplied by Mr G. P. Whitley, then Ichthyologist, Australian Museum) some of the early references (including some quoted in the present paper) to this species. A passage (p. 90) designating a type locality for Cuvier's species may fittingly be quoted here. 'Dealing with an excursion made [during the visit of Baudin's expedition to the D'Entrecasteaux Channel district, 13th January - 13th February 1802] by a party in the neighbourhood of the "Rivière Fleurieu" inland from "le port des Cygnes," Péron (1807, p. 234) remarks, ". . . ils y avaient aussi vu de nombreuses truites; et M. Lesueur m'en rapportoit quelques-unes qu'il avoit tuées d'un coup de fusil." It seems very probable that these "truites" were *Galaxias truttaccus*, and, on the evidence available, I venture to redesignate the type-locality of this species as Agnes River (Rivière Fleurieu of Péron), South Eastern Tasmania.'

2. PROPOSED RELEGATION OF *G. attenuatus* AND *G. alpinus* TO SYNONYMY OF *G. maculatus*

2.0 The proposal. — On Darwin's Beagle material Jenyns (1842) founded his *Mesites*, with three species, *M. maculatus*, *M. alpinus*, *M. attenuatus*, the first two from South America, the third from New Zealand. The incorporation by Cuvier & Valenciennes (1846) of *Mesites* in *Galaxias* (Jenyns appears to have been unacquainted with Cuvier's genus — a circumstance that is, perhaps, not without a moral in connexion withc Cuvier's 'alleged ignorance' of Forster's New Zealand fish) has usually been accepted; though some writers (*e.g.*, Whitley, 1933 : 61; 1960 : 28) follow Ogilby (1899 : 158) in referring one or more of Jenyns' species to *Austrocobitis* Ogilby (substitute for *Mesites* Jenyns, preoccupied). [For history of *Austrocobitis* see Scott (1966)].* Stokell states 'the three species cannot be regarded as distinct' (p. 77); all thus coming to be known as *G. maculatus* (Jenyns), which name has page priority.

2.1. The argument. — Direct consideration of Jenyns' three species is found in the first paragraph of p. 77 (quoted below, 2.12). the rest of this section of the paper (pp. 76-78) being devoted to a discussion of the three subspecies there recognized (for status of the proposed Tasmanian and mainland Australian subspecies, see section 3, below).

2.11. However, one point on p. 76 calls for attention here. The statement, 'The fish known as *Galaxias attenuatus* in Tasmania differs materially from the form bearing this name in New Zealand' introduces a review of certain meristic characters, the penultimate sentence of which begins 'Three specimens from Chile, where the fish is known as *G. maculatus* . . .' These three Chilean specimens are then regarded as belonging to the South American subspecies of a species having also New Zealand and Tasmanian (and mainland Australian) subspecies : and the whole question of the trivial name seems thus to be begged.

2.12. For convenience of discussion (2.21) each of the sentences of the first paragraph on p. 77 here quoted is prefixed by a reference letter in square brackets '[*a*] All Jenyns' descriptions were based on juvenile examples from about two inches to about two and a half inches in total length. [*b*] In view of the differential growth prevalent in these fishes during the transition from the juvenile stage to the adult stage the proportional measurements have little definitive value. [*c*] Colouration, to which much importance was attached, also shows a considerable change at this stage. [*d*] When the New Zealand fish come in from the sea they are unpigmented except for the eyes and vertebral column, the normal colour pattern commencing to develop after a short residence in fresh water. [*e*] The most important character recorded in the original descriptions is the number of anal fin rays which is given as 15-16 in *maculatus*, 16 in *alpinus* and 17 in *attenuatus*. [*f*] These figures are not sufficiently different for specific separation, and the three forms as described cannot be regarded as distinct.'

2.2. Rejoinder. — It is here contended the proposed lumping of Jenyns' three species stands unproven. It is possible, indeed, a thorough investigation might establish identity among all or some pair of these forms : however, the case presented in the paper under review is too limited in scope of characters considered, is based on too little material (no examples at all of *G. alpinus* appear to have been examined), and is of far too conjectural a nature to justify the immediate nomenclatural changes made.

2.21. Some observations on the passage quoted in 2.11 follow.

2.211. [*a*]. It is true that Jenyns' types were small fish (approximate lengths in mm : *G. maculatus* 55-58, *G. alpinus* 56-62, *G. attenuatus* 63). However, Regan (1906) accepted Jenyns' three species as valid, having before him examples of *G. maculatus* up to 120 mm, and of *G. attenuatus* up to 135 mm (with South American individuals up to 110 mm); though in the case of *G. alpinus* he had access only to the types.

2.2121. [*b*]. The implied problem of distinguishing, on metrical characters, between fish of different species of the size of Jenyns' material does not, in

* In an early paper (1936) the writer made brief reference to fin posture among Galaxiids. Several years ago when identifying species of Galaxias in the local whitebait he was struck afresh with the difference in the insertion and the set of the pectoral in G. attenuatus as compared with the other Tasmanian species, and incorporated these features in working keys to the fry. This feature also attracted the notice of, and has been found of use in the identification of juveniles in New Zealand whitebait by, McDowall (1964 : 140), who gives an excellent description of fin's form and position. Whether this type of pectoral is confined to G. attenuatus (or to a small group of species — among which G. maculatus, if genuinely distinct, and/or G. gracillimus (Canestrini, 1864) at once suggest themselves), and whether, if this be the case, it may render advisable the use of Ogilby's name Austroeobitis for this species or these species are points worthy of investigation and consideration.

the writer's experience, exist. Without knowledge of a species' life history, indeed, an observer may find difficulty in associating a juvenile with an adult, though even this situation would, in general, be likely to be really awkward with fish at a very early stage. Young *G. attenuatus* on the vernal inland migration have on arrival, about October, near Launceston, Tasmania, in Punchbowl Creek, which connects with the North Esk upwards of forty miles from the sea, a total length of about 45 mm, and attain a size comparable with Jenyns' larger individuals only towards or at the end of their first summer: however, even on arrival in the Creek these fish are specifically determinable almost at a glance. [For a study of these immigrant fish, see Scott (1938)].

2.2122. Woods (1963 : 29) has defined whitebait [in the New Zealand connotation of the term; which has at least half a dozen meanings in as many countries] as 'The transparent, free-swimming and shoaling juveniles of at least five species of galaxias.' His outline figures depict clearly distinguishable forms (as reproduced, they range from 35 to 52 mm in total length : no scale is noted, but the illustrations may well be life size). McDowall (1964), who discusses proportions, meristic characters, pigmentation, and provides good figures, concludes 'The "whitebait" of the fisherman is thus presumably *G. attenuatus*, with *G. fasciatus*, *G. postvectis*, *G. brevipinnis* and probably *G. argenteus* making up a small proportion of the catch' (p. 145) : *G. campbelli* may also be involved (Woods). In Tasmania the whitebait fishery was formerly based almost wholly on a small endemic Aplochitonid, *Lovettia sealii* (Johnston, 1883), the biology of which has been thoroughly studied by Blackburn (1950). In recent years, however, Galaxiids, previously of quite minor importance, have become the main constituents of the whitebait runs, the species encountered in northern rivers (Lynch, 1965 : determinations by present writer) being *G. attenuatus*, *G. truttaceus*, *G. weedoni*, with a modal standard length of 40-50 mm. So well marked are specific differences, even in samples taken but a short distance inland (quite shortly after, at times before, the onset of pigmentation) that a leaflet, drawn up by the present writer at the request of the Inland Fisheries Commission and distributed by that body to anglers makes possible species determination by any careful observer.

2.21221. In assessing the importance attachable to the above observations, from 2.121 onward, on the relative ease with which it has in practice been found possible to sort out fry into species, it should be borne in mind that the New Zealand and Tasmania species mentioned are probably, at least in general, more trenchantly separable from one another than are Jenyns' trio of species.

2.2123. Differential growth occurs, in a number of morphological features, throughout most, or the whole, of life in many, if not all, Galaxiids—for a study of differential growth in *G. attenuatus* see Scott (1938). However, the resultant changes in proportion follow, as far as the matter has been investigated, a regular species pattern, so that, as already indicated, even quite juvenile examples of different species present well marked differences in metrical (and meristic) characters from one another. It may be remarked that if this were not so, the circumstance would negate the very conclusion Stokell has based on the small size of Jenyns' specimens. If the fish were too small to exhibit characters adequate for their taxonomic separation, equally they would be too small to exhibit characters adequate for the taxonomic act, equally positive, of declaring them conspecific.

2.213. [*c*], [*d*]. The observation in [*d*] has no direct bearing on the present situation, Jenyns' fish being past the onset of pigmentation. Coloration, as observed in [*c*], undergoes change, usually very considerable, during the postlarval and juvenile stages—for example, an early barred phase in *G. truttaceus*, the adult of which is ocellated, has been reported (Scott, 1941). Nevertheless, specific histories are followed through; differential patterns of coloration in the species of *Galaxias* occurring in Tasmanian whitebait being evident from the earliest appearance of pigmentation.

2.214. [*e*]. Apart from the mention of the fact that radiographs of the types in the British Museum give for *G. attenuatus* 64 vertebrae, and for *G. maculatus* 64, 61, 63 (type, two cotypes)—all of which values Stokell suggests should be reduced by one, as he considers they probably included the urostyle, which is not included in his own counts (such amended values would tell, if anything, against the suggested conspecificity of *G. maculatus* and *G. attenuatus*, bringing the minimum for the former one below the lowest value ever recorded for New Zealand specimens of the latter)—the similarity, in one instance the overlapping, of the number of anal rays as recorded by Jenyns for his three species is the only direct evidence advanced in favour of their conspecificity.

2.215. [*f*]. In the general account of his *Mesites* Jenyns observes (p. 119), 'Mr Darwin's collection contains no less than three species of this new genus, differing but slightly from each other'. On commenting on his specific diagnoses, however, he says (p. 121) of his *M. alpinus* 'I have no hesitation in considering it distinct from the last' [*i.e.*, *M. maculatus*], and (p. 122) of his *M. attenuatus* 'This, which is a very distinct species of the new genus'. It may be noted in passing that *M. alpinus* was taken in Hardy Peninsula, Tierra del Fuego in 'alpine fresh-water lakes', a possible, but not very likely, habitat of *G. attenuatus*. Differences that permit the keying of the three forms were observed by Regan. Restriction of the comparison between them to the one or two features selected by Stokell fails to make adequate use of available data, and surely does not provide satisfactory grounds for asserting the three named forms are conspecific.

3. STATUS OF PROPOSED TASMANIAN (AND MAINLAND AUSTRALIAN) SUBSPECIES OF *G. attenuatus* AND VALIDITY OF ITS PROPOSED SUBSPECIFIC NAME *iguotus*

3.0. The proposals.—*(a)* A Tasmanian (and mainland Australian) subspecies of the species hitherto known as *Galaxias attenuatus* is described (p. 78). *(b)* Synonymisation of *G. attenuatus* with *G. maculatus* followed by the recognition of three subspecies automatically leads to the names of the South American and New Zealand forms being *G. maculatus maculatus* and *G. maculatus attenuatus*,

respectively : for the proposed Tasmanian and mainland Australian subspecies established the subspecific name *ignotus* is published.

3.1. The argument.— *(a)* The three subspecies are founded solely on three meristic characters, frequency distributions being given for number of vertebrae and number of branched anal rays and ranges being noted for number of branched dorsal rays. *(b)* The section dealing with the name of the subspecies for which a full description is provided is here quoted.

3.111. 'Many nominal species have been proposed from Australia, some of which have been regarded as synonyms of *attenuatus*, but even if they could be identified from the scanty data furnished most of them would not be available now. *G. kreffti* Günther (1866) has never been recognised and is now a *nomen oblitum*. *G. punctatus* Günther (1886), *G. waterhousii* Krefft (1867), *G. cylindricus* Castelnau (1872), *G. delicatulus* Castelnau (1872), *G. nebulosus* Macleay (1881) and *G. obtusus* Klunzinger (1872) appear to be in the same category. They were not included as valid species in the list of Regan (1905) and McCulloch (1929), in consequence of which they are judged to be lapsed names. *G. versicolor* Castelnau (1872) was included in both Regan's and McCulloch's lists and would still be available. It is described as having a total of 12 rays in the anal fin which disqualifies it as a species to which the Australian form known as *attenuatus* could be referred.

3.112. '*G. amaenus* Castelnau (1872) which also has been kept alive by inclusion in Regan's and McCulloch's lists is described as having a head in total length of 4⅓. This indicates a much longer head than ever occurs in the fish known as *attenuatus* in Australia. These fish are very poorly described, and the account of *versicolor*, at least, is based on a single specimen. *G. seriba* Cuvier and Valenciennes (1846) may have been saved from lapsing by Whitley's (1933) use of the name in the trinomial *Galaxias attenuatus seriba* Cuvier and Valenciennes, but the matter is of little consequence, as the length of the head and the form of the caudal fin recorded in the description of *seriba* differ substantially from those of the Australian and Tasmanian fish commonly regarded as *attenuatus*.'

3.2. Rejoinder.— *(a)* It is here suggested the characteristics, and therewith the validity of the proposed Tasmanian (and mainland Australian) subspecies could well be the subject of further investigation; *(b)* it is contended that, if this form is valid, its name should be *Galaxias attenuatus seriba* Cuvier & Valenciennes, 1846, not *Galaxias maculatus ignotus* Stokell, 1966.

3.21. It is not proposed here to examine critically the taxonomic status of the proposed three subspecies, a matter on which, without access to extensive series of fish from South America, New Zealand, mainland Australia and Tasmania, the writer is not prepared to express a considered opinion. However, in passing, several comments may be made. It is apparent that the basing of the South American form on three meristic characters of three individuals is a hazardous proceeding — with the assumption that the integral variates can be treated as a continuous series with a normal distribution, there is no statistically significant difference between the South American and New Zealand values for number of vertebrae ($t = 0.08$), or between the South American and New Zealand values for number of vertebrae ($t = 0.08$), or between the South American and Tasmanian values for number of branched rays ($t = 1.05$). For the Tasmanian form the ranges given for branched anal rays, branched dorsal rays are 13-16, 6-8; but both upper extremes cited are exceeded in our fish. No reference is made by Stokell to the three 'races' recognised by Regan, or to other characters considered by him (length of head, size of eye, location of ventral, shapes of dorsal, anal and caudal fins).

3.221. Though the prime issue here is the standing of Cuvier & Valenciennes' 1846 name for a possible Tasmanian subspecies, portion of the discussion in Stokell's paper immediately preceding his direct consideration of this name has been given above (3.11) to permit the calling of attention to several minor points. The date of *G. punctatus* is 1866 (the 1886 being a misprint, as is evident from the position of the entry in a chronological list). Macleay's species was described (1881:234) with trivial name *nebulosa;* which form is retained by both Regan (1906:368) and McCulloch (1929:48). The name *G. amaenus* Castelnau, 1872, spoken of as being kept alive by inclusion in Regan's and McCulloch's lists does not appear in Regan's paper (1906). This species has been synonymized with *G. attenuatus* by Mack (1936:99).

3.222. Of the names noticed as possible synonyms, the earliest, *G. seriba* Cuvier & Valenciennes is rejected (3.11) on length of head and form of caudal fin.

3.2221. The original description reads 'La longueur de la tête est comprise cinq fois dans la longueur totale'. [Macleay (1881), whose diagnoses of species on which he had no additional information to present usually follow those of Günther introduces an adventitious element of confusion by speaking of 'total length (without caudal)' in place of Günther's '(with the caudal)' (1866:212]. The statement that such a value differs 'substantially' from that found in *G. attenuatus* is not in accordance with fact, being based perhaps on inadequate acquaintance with the species. While a head 5.0 in total length (including caudal) is quite unusual, a value as low as 4.9 occurs in Tasmanian fish. Values of 'five', if interpreted as nearer five than six, are by no means uncommon: thus in Stokell's own Tasmanian sample of 15 specimens head in standard length is given (p. 74) as 4.70-5.73, mean 5.16, this minimum value being equivalent in many individuals to a head in total length ratio of nearer 5 than 6.

3.2222. The caudal fin is described as 'carée'; in Günther's account 'truncated'. This undoubtedly presents some difficulty. Perhaps all than can be said is *(a)* that the caudal, described by Regan in his species diagnosis of *G. attenuatus* as 'slightly emarginate', is, as pointed out by him 'usually not quite so distinctly emarginate' in the Australian 'race' as in the New Zealand 'race'; *(b)* considerable individual variation in the degree of emargination is encountered, some examples showing little sign of the lobes or shoulders usually developed; *(c)* in the fish from the Derwent River identified by Richardson (1848:76) as *G. seriba* the caudal is 'forked at the end'; *(d)* no known Australian *Galaxias* capable of being confused with *G. attenuatus* has a truly square caudal.

3.2223. One problem (not noted by Stokell) is the large eye, which is stated to be only two and a half times in the head. This value is not only numerically low for *G. attenuatus*, in which values below the '3 (young)-5' reported by Regan are very seldom met with, but it is also unusual for any species, being lower than that given by Regan for any of the more than a score of species he examined (of these, 4, including *G. attenuatus*, have values down to 3.0). However, Regan, who handled the holotype of *G. scriba*, states the eye is 'slightly more than ¼ the length of head' — a value quite compatible with *G. attenuatus*. As Regan observes, 'The varying size of the eye in preserved specimens is sometimes due to the method of preservation: often the eye tends to protrude and the circular fold surrounding it is stretched or broken, thus apparently increasing the size of the eye.' That this may well be the case with the type of *G. scriba* is suggested *(a)* by the fact that Regan's sentence just quoted immediately follows, and is apparently an express comment on, his statement of eye-size in that specimen; *(b)* by Cuvier & Valenciennes' reference to the eye as 'plus saillons'.

3.2224. The long body — the height being given in the original account as ten times in the total length — would seem to point strongly to *G. attenuatus.*

3.2225. It is evident, therefore, that the interpretation of *G. scriba* as synonymous with *G. attenuatus* is, as noted by Stokell, not free of difficulty. Systematists with some experience of attempting assessment, in terms of modern taxonomic practice, of early generic and specific accounts would, indeed, commonly be agreeably surprised to find such a description without some perplexing point. However, having in mind *(a)* that Regan, with Cuvier & Valenciennes' type before him, synonymized their species with Jenyn's *G. attenatus*; *(b)* that *G. scriba* has been recorded from Tasmania by Richardson (1848:76), whose example from the Derwent River is almost certainly referable to *G. attenuatus*; *(c)* that, since Regan's revision, Australian authors in general have treated *G. scriba* as a synonym of *G. attenuatus; (d)* that Whitley (1933; and later) uses the trinomial *Austrocobitis attenuatus scriba* (see Stokell's comment quoted above in 3.11); and considering the general tenour of the above discussion, it would seem that, if an Australian (including Tasmanian) subspecies is recognised, the appropriate name for it is *Galaxias attenuatus scriba* Cuvier & Valenciennes, 1846, or (in accordance with an increasingly common practice of dropping Cuvier's name where the actual account is by Valenciennes alone — a procedure not adopted on Stokell's paper, and hence, for convenience of exnosition here not adverted to earlier) *Galaxias attenuatus scriba* Valenciennes, 1846, not *Galaxias maculatus ignotus* Stokell, 1966.

4. SUGGESTED IDENTITY OF *Galaxias auratus* AND *Galaxias weedoni*

4.0. The proposal. — Speaking of *Galaxias auratus* Johnston and *Galaxias weedoni* Johnston, 1883 — with which latter Regan and subsequent writers have synonymised *G. atkinsoni* Johnston, 1883; trivial name rendered *atkinsonii* by Regan (1906:378) — Stokell observes 'It seems questionable if these two nominal species are distinct' (p. 76).

4.1. The argument. — Referring to radiographs furnished by the British Museum, and reproduced as Plates I, II, of one specimen each of *G. auratus* and *G. weedoni*, both presented to that institution by Johnston himself, Stokell observes, 'The print of *G. auratus* shows 55 vertebrae definitely, but that of *G. weedoni* is less certain. At the posterior extremity several bones are disturbed and not clearly shown, but counting the neural spines in this short section and estimating the intervals the number appears to be 55 also. It seems questionable if these two nominal species are distinct.' No other evidence for or against conspecificity is mentioned. [On p. 76 it is stated that radiographs of three species, the present two and *G. affinis* Regan, 1906, are reproduced in Plate I; but in the setting up of the paper the three figures have come to constitute three separate plates, numbered I - III].

4.2. Rejoinder. — Johnston's two species are good species, are quite distinct, and there is no reasonable possibility of their being confused.

4.21. It will be observed that the argument for identity depends solely on the fact that in each of the two British Museum specimens the vertebrae are counted as 55.

4.211. Reliance on vertebral counts (at times in the complete or virtual absence of other criteria) is a feature of the paper. 'The most important of the specific characters used is the number of vertebrae. In addition to being a basic osteological character it has a particular value in differentiating species on account of the general lack of correlation between it and certain proportional measurements such as the length of the head in relation to the standard length' (p. 73). While vertebral complement is certainly a basic osteological character, it is by no means a specific constant, being in general equally variable with the more stable of the meristic and other quantitative characters commonly employed in diagnosis — thus, from Stokell's Table 5 the vertebral counts of four sets of material apparently representing as many species have ranges (in terms of filled cells of a unitary frequency distribution) of 5, 4, 4, 3, mean 3.75, while from Table 6 for virtually the same material (one additional specimen in one set, two additional specimens in another) the ranges of branched anal rays are 2, 3, 3, 2, mean 3.33. As with most other meristic characters the vertebral count can be employed definitively only in the form of a frequency distribution. Interspecific overlapping in vertebral counts is of the same order of magnitude as interspecific overlapping in anal and dorsal ray counts.

4.212. The assumption is here made that the occurrence in the two British Museum speciens of the same vertebral count indicates their probable conspecificity. By parity of reasoning all individuals among the four groups of Table 5 that happen to have 60 vertebrae (or, indeed, 61) belong to the same species. [In Tables 5, 6, 7 the question-mark following *G. attenuatus* and that following *G. truttaecus* indicate dubiety, not as to species determination as such, but as to the taxonomic propriety of the trivial name employed]. Again, an individual fish with 59 vertebrae can, by this procedure together with total neglect of indications afforded by other characters, be held to be a specimen of *Galaxias attenuatus, G. lynx, G. fasciatus, G. alepi-*

dotus, G. brevipinnis, G. postvectis and other species. The existence in two individual fish of the same vertebral count clearly could, in itself, indicate specific identity only in the situation that the form to be regarded as definitive has as this total a value (whether as a unique count or as a term in a distribution) that lies wholly outside the ranges of all other species (a condition likely to be fulfilled but seldom): for some data on overlapping values, see, *e.g.*, Stokell (1945, table II).

4.221. Reference, first, to Regan's key (p. 366), secondly, to his diagnoses (pp. 377, 379), thirdly, to his illustrations (pl. X, fig. I; pl. XIII, fig. I) surely offer good evidence of specific distinctness. Johnston's measurements and sketch of his type of *G. weedoni* have been made available by the redaction of his memoranda by Whitley (1929).

4.222. Some significant differences are evident on comparison of the radiographs published by Stokell of *G. auratus* (pl. I) and *G. weedoni* (pl. II). These include the existence in *G. auratus* of *(a)* larger head, *(b)* more posterior insertion of ventrals, *(c)* shorter ventral-anal interspace, *(d)* shorter caudal peduncle relative to length of anal base (note, however, length of anal base in *G. weedoni* is greater than is immediately apparent from the illustration, the fin including posteriorly a couple of rays of which only proximal fragments are preserved), *(e)* larger bases of vertical fins, *(f)* longer lower jaw.

4.2231. *G. weedoni* and *G. auratus* can be immediately separated on color pattern alone. Markings found in *G. weedoni* are of the same general type as those of a number of other forms — closely approaching, in examples predominantly barred and blotched, *G. parkeri* Scott, 1936, and in examples in which spots are more largely developed, *G. affinis* Regan, 1906: essentially similar patterns characterise a number of extralimital forms. [This pattern appears to be the norm in the genus *Saxilaga* Scott, 1936]. The pattern of largish clearly rounded spots and anterosuperior vertically set ellipses of *G. auratus* is quite unlike that of any other Tasmanian, and not closely paralleled by that of any extralimital, Galaxiid.

4.2232. Some of the characters useful in distinguishing between Johnston's two species are set out in Table I. Unbracketed entries in the second and third columns are general specifications. In the column headed *Galaxias weedoni* material in square brackets comprises three sets of data — first, a verbal specification or numerical value, obtained, where so indicated, by estimation from Johnston's figure (Whitley, 1929; pl. II, fig. 1), or calculated from Johnston's measurements, of his type (Whitley, 1929: 46); secondly, data yielded by a specimen, standard length 115 mm. total length 133, one of the examples handled by Regan, which the present writer examined some years ago by courtesy of the Australian Museum, Sydney; thirdly, data, comprising, in the case of metrical entries, ranges, mean, and (to present some evidence of the reasonably normal order of magnitude of the variability of the sample) coefficient of variation, yielded by 11 examples (standard lengths 75, 79, 84, 92, 95, 95, 96, 97, 104, 109, 115 mm, total lengths 91, 92, 98, 108, 111, 128, 108+, 111, 111, 121, 135 mm, respectively) from Crater Lake, Cradle Mountain (W. Connell). In the column headed *Galaxias auratus* material in square brackets is derived from a pooled sample of 2 individuals (standard lengths 65, 83 mm, total lengths 77, 93 mm) from Clyde River, ¼ mile below Lake Crescent at the road bridge (D. F. Hobbs) and 6 individuals (standard lengths 62, 68, 68, 71, 72, 78 mm, total lengths 73, 80, 82, 82, 84, 92, respectively) from Clyde River, Lake Crescent (B. C. Mollison). In both these columns material in round brackets is derived from Regan (1906). In the last item considered (Coloration) this usage of brackets is not observed; the account given being, for typographical economy, a conflation of known data.

4.23. Adult topotypical examples of *G. weedoni* are not available, but the writer has identified and measured several hundreds of juveniles from the Mersey River (type locality) and from other rivers belonging to the same general drainage system and flowing into the sea along the north-west coast of Tasmania. *G. auratus* was stated (Johnston, 1883: 141) to be 'confined to the neighbourhood of the Great Lake, at an altitude of about 4000 feet', while the example noted in his memoranda (Whitley, 1929:47) came from Lake Sorell. The source of the material used in the compilation of Table I, Lake Crescent, is just south of, and in direct communication with, Lake Sorell. The writer has not seen specimens taken in recent years from Great Lake itself, though large fish dating back to the last century and believed to come from this locality are known.

4.24. In juveniles of *G. weedoni* the pectorals are very large, exceeding in magnitude all other fins save the caudal. Specimens kept in captivity have been observed to possess particularly well developed powers of climbing, the pectorals being used for adhesion. When at rest the fish lies upon the bottom in an attitude similar to that of *G. parkeri*, curiously suggestive of a tetrapod in repose.

4.25. In a suggested sorting of Tasmanian species of *Galaxias* into three groups (1936:94) *G. weedoni* was associated with *G. johnstoni, G. parkeri, G. atkinsoni* if distinct, and, rather towards the fringe of the assemblage, *G. affinis; G. auratus* was placed with *G. truttaceus* and *G. scopus*, if distinct; the third category being represented only by *G. attenuatus*. Later information tends, if anything, to confirm the usefulness of this somewhat *ad hoc* classification.

NOTE ADDED IN PRESS

While this paper has been in press further data on components of New Zealand Whitebait (see section 2.2122, above) have been provided by McDowall (McDowall, R. M., 1966.-Further observations on Galaxias Whitebait and their relation to the distribution of the Galaxiidae. *Tuatara*, 14, 1: 12-18; New Zealand Fisheries Publication No. 74). If it indeed be the case that the contentions of the present paper are valid, it is unfortunate the delay in publication has permitted the appearance in the literature of a nomenclatural change against which objection is here advanced (*e.g.*, synonymization of *Galaxias attenuatus* with *G. maculatus* in McDowall, R. M., 1967.-New land-locked fish species of the genus *Galaxias* from North Auckland, New Zealand. *Breviora*, 265: 1-11).

TABLE I

COMPARISON OF *Galaxias weedoni* JOHNSTON, 1883 AND *Galaxias auratus* JOHNSTON, 1883

In the column headed *Galaxias weedoni* the first of the three entries in square brackets relates to the type, the second to a specimen from Regan's material, the third to a series of 11 specimens from Crater Lake, Cradle Mountain : in the column headed *Galaxias auratus* the entry in square brackets is based on a series of 8 specimens from Clyde River, Lake Crescent. In both columns entries in round brackets are derived from the accounts and figures of Regan (1906)

FEATURE	*Galaxias weedoni*	*Galaxias auratus*
Head in standard length	About 4⅓-5 [4.4. 4.8. 4.3-5.1, $\bar{x}$ 4.62 ± 0.02, *V* 1.4± 0.03] ('5')	About 3½-4 [3.5-4.0, $\bar{x}$ 3.72 ± 0.07, *V* 5.4 ± 1.3] ('About 4': measurements of Johnston's specimen, on which Regan's account is based, yield 3.9)
Relative length of jaws	Upper longer [From figure, upper longer. Upper longer. Upper longer] ('Lower jaw slightly shorter than upper')	Equal or lower longer [Lower longer] ('Jaws equal anteriorly')
Ventral inserted midway between caudal base and point specified	Anterior nostril-tip of snout [From figure, front half of snout; from measurements 0.7 of snout. Tip of snout. Tip of snout-anterior nostril] ('Tip of snout')	Preoperculum [Between posterior border of preoperculum (modal) and shortly behind eye] ('Posterior margin of praeoperculum')
Ventral-anal interval *(a)* In preventral length	About 1.8-2.2 [2.1. 1.8. 1.9-2.2, $\bar{x}$ 2.04 ± 0.03, *V* 5.2 *V*±1.1] (From figure, 2.1)	About 2.4-2.7 [2.4-2.7, $\bar{x}$ 2.54 ± 0.04, *V* 4.8 ± 1.2] (From figure, 3.1)
(b) Times anal base	>2 [From figure, about 2.6. 2.7. 2.4-2.8, $\bar{x}$ 2.56±0.06, *V* 7.1±1.5] (From figure, about 2.3)	< 2 [1.6-1.9, $\bar{x}$ 1.71 ± 0.04, *V* 9.8 ± 1.5] (From figure, about 1.7)
(c) Relative to head	> [1.1. 1.3. 1.1-1.3, $\bar{x}$ 1.19 ± 0.02, *V* 5.9 ± 1.3]	< [0.7-0.9, $\bar{x}$ 0.82 ± 0.02, *V* 5.5 ± 1.4] (From figure, 0.7)
Anal base relative to caudal peduncle (anal termination-hypural joint)	≥ [From figure, about 0.8. 0.8. 0.8-1.0, $\bar{x}$ 0.82 ± 0.02, *V* 8.0 ± 1.9] (From figure, about 0.8)	> [1.1-1.5, $\bar{x}$ 1.25 ± 0.04, *V* 9.4 ± 2.4] (From figure, about 1.1)
Combined dorsal and anal bases in combined trunk and tail, without caudal fin	> 3½ [From figure, about 4.5. 4.0. 3.7-4.3, $\bar{x}$ 4.1 ± 0.05, *V* 4.4 ± 0.9] (From figure, about 4.1)	< 3½ [3.1-3.4, $\bar{x}$ 3.29 ± 0.04, *V* 3.2 ± 0.8] (From figure, about 3.1)
Coloration *(a)* Body	Brownish or olivaceous, liberally marked with darker in variable combinations of more or less perfect bars, chevrons, blotches, spots, vermiculations — usually marks other than spots, sometimes spots predominating : spots not clearly and regularly rounded. A more or less clearly developed dark postpectoral bar	Reddish or yellowish, marked, particularly (often only) on the back and upper part of the flank with purplish spots: some of the anterior spots may be (usually are) more or less elliptical (major axis vertical), the remainder being clearly and regularly rounded. No dark postpectoral bar
(b) Fins	Dorsal, anal and caudal usually with some moderate-sized dark spots. No fins with dark margins	Dorsal, anal and caudal regularly unspotted. Dorsal, anal and ventral with black or blackish margins

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No. 30

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WHAT DO WE KNOW OF TASMANIAN LANGUAGE?

by

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INTRODUCTION

The Tasmanian language or languages (or perhaps dialects) has not been spoken for nearly a century. The records left are fragmentary and the orthographies so poor that it would seem that neither vocabulary nor grammar could ever be recovered from them.

The materials available to the modern student consist of a number of vocabularies, English-Tasmanian, and a number of sentences. Of running text there is practically nothing, and the translations of the sentences often seem to be completely hopeless in their inaccuracy. Various writers, such as H. Ling Roth, have attempted to write a Tasmanian grammar and to prepare a Tasmanian-English vocabulary, but the results have been far from satisfactory. H. B. Ritz, in various numbers of the Proceedings of the Royal Society of Tasmania has endeavoured to reinterpret the vocabularies and one or two of the songs, but without any more success: in fact his translations are so closely attached to a special theory of original roots and meanings that the theory vitiates the attempt.

That remarkable anthropologist-linguist, the late Fr. Wilhelm Schmidt, who worked so hard on the study of Australian languages — and never heard one spoken — worked no less hard to produce an analysis of the remains of Tasmanian. In 1952 he published his 580-page book, Die Tasmanischen Sprachen, in which he extracted every ounce of fact that one could hope to extract from the existing documents — and perhaps a few more in excess! It was a really remarkable piece of work. In the preface he stated that it had been finished in 1919, but he had kept it in manuscript in the hope that more material might be discovered. In 1952 he gave up the hope and published the book as it stood. Ironically enough, it was in that very year that further documents did appear, when G. A. Robinson's diaries were re-discovered. These were edited by Mr. N. J. B. Plomley, who passed on to the present writer the linguistic materials contained in them, although these do not provide any basically new information. Fr. Schmidt lived just long enough to know that these materials had been found, but he never saw them and of course never used them. They are taken into account in the present paper for the first time. The only other worker in the field of Tasmanian linguistic interpretation is, strangely enough, another priest, the late Fr. E. A. Worms, whose paper in Anthropos 1960 on "Tasmanian Mythological Terms" remains the only effort, apart from Fr. Schmidt's, to interpret the sound system of the language and deal with some of the brief texts that survive.

Some little insight into the structural features of the language may be gained from the documents. In fact, Friedrich Müller in his Grundriss der Sprachwissenschaft (Vienna, 1885, Vol. II, pp. 87-9) had made a brief analysis of the grammatical features.

Phonetic study, as against grammatical, seemed impossible, just because the language had died out before the days when instrumental recording was possible. Later, however, it appeared that this was not entirely the case. A few recordings of spoken and sung Tasmanian text were made through a mixed-blood, Mrs. Fanny Cochrane-Smith. These were taken on Edison cylinders in 1899 and again in 1903 by different workers — Mr. J. B. Walker, F.R.G.S., and Mr. Horace Watson. Copies were taken from these cylinders in 1909, and in 1949 the Australian Broadcasting Commission made tapes from the now broken cylinders. The processes of repair of the cylinders do not add to the clarity of the recordings, already difficult owing to the imperfection of the early machines, and it is far from being a simple task to pick out sounds from them. It is still doubtful whether detailed phonetic study of the songs would be at all rewarding. The best line of advance still seems to be a re-examination of Schmidt's and Müller's morphological analyses, using what little extra sentence material is available from Robinson, and that is the purpose of this paper. While this is therefore essentially a review paper, a different approach has been made to the materials, in terms of modern linguistics, in a way that was not possible for either Müller or Schmidt.

Firstly, what are these materials? On the spoken, or rather sung, side, the tapes of Mrs. Cochrane-Smith's singing. These yield less than was hoped. On the written side, the vocabularies and sentences from early days. These were analysed in great detail by Schmidt in his book, but they repay further analysis from a different viewpoint. When different questions are asked, a different answer may sometimes be obtained. Hitherto all the work has been based on presuppositions resting on European grammar, and Schmidt's attempt is no more free from these presuppositions than any other, especially in the analysis of the verb. A different kind of analysis will be given here, based on a tagmemic approach to existing texts.

PHONOLOGY

One or two remarks must suffice concerning the phonetics of the language, since this paper is going to be concerned chiefly with morphology. The presence of two series of stops, voiceless and voiced, is rare on the mainland of Australia, and even in parts of Melanesia they are not found. It seems very unlikely that they existed in Tasmania. For this reason, pending what analysis can be made of the tapes, I am using here the series /p, t, t', k/. The nasals of the series seem all to be present: /m, n, ñ, ŋ/. Schmidt posited a pharyngeal fricative for he supplied a special symbol. The evidence seems to me quite insufficient; if a back frieative existed (and it depends on Schmidt's interpretation of varying spelling in the sources) it could just as well have been the velar fricative /γ/, which occurs also on the mainland of Australia. One interesting point is the occurrence of /l/ and /r/ as phonemes, and these quite frequently in the initial position. Initial laterals and rolled consonants are somewhat rare in Australia, and many of the languages do not permit them at all.

Absence of sounds is also in this connection worthy of notice. Tasmanian agrees with Australian in the almost complete absence of fricatives. As in Australian /s/ and /h/ appear to have been absent, as well as /f/ and /v/, the latter of which does occur in Australia though it is rare.

Although the consonant system apparently compared very closely with the Australian, as already stated, one exception seems necesary to Schmidt's transcription, and that is the existence of interdental /t/. In a song recorded by N. B. Tindale on Cape Barren Island in 1939, such interdentals were present, and in a discussion at the Hobart A.N.Z.A.A.S. meeting in 1965, following on the presentation of the original form of this paper, a Cape Barren Islander present asked whether "th" sounds were not present in Tasmanian, as he understood from his area that they had been. The occurrence of such sounds may therefore be accepted, and they are here used (with the symbol /t/) where the sources use "th" — which would then seem to be not a mistake, as most have assumed, but the recognition of a special sound for which no single symbol was to hand. It seems highly likely that Schmidt's two western words plöara(ba), mouse, and /ptönara/, eold, stand for /toara(ba) and /tönam/.

Schmidt also posited the two mixed vowels /ö/ and /ü/, of which only /ü/ is documented in the sources, as it is by direct mention. In point of fact the occurrence of /ü/ is remarkable, and not to be expected in the given case, but it is accepted on the authority of Milligan by Schmidt and seems to be correct. In general, Schmidt's analysis of the sound system is acceptable in most points, except his claim that the language posessed the laryngeal fricative called 'ain in Arabic. His claim is here based on variations in the orthography of words, which he believes is due to the presence of a sound which observers could not recognise in any European language known to any of them. While, of course, it is possible that Schmidt is right, it seems far more likely that the sound required is the velar fricative /γ/, the sound of intervocalic "g" in the North German pronunciation of words such as Wagen, Steigen, etc., and the symbol /γ/ is used here in such cases. The mixed vowel /ö/, similarly, does not seem to answer to the German rounded /ö/ in either variety, but is more probably to be taken as the unrounded vowel found in English "but". This is common in Australian languages, and is stated in the sources to be intended by u followed by two consonants, when, says Milligan, it sounded "as in the English words musk, lump, bump, etc.". The symbol /ö/ has been retained here partly for ease of comparison with Schmidt's results, and partly for case of printing, rather than the inverted v which is the common phonetic symbol for the sound.

Australian languages have basically a three vowel system, /i, a, u/, with a great deal of conditioned and free variation* and it is more than likely that Tasmanian was similar in this regard.

In all language study, not only are individual phonemes of importance, but their combinations in syllables, and their behaviour under stress. In Tasmanian it is extremely hard to make statements about syllable structure or stress, because it is not possible to listen to living speakers. Something may be gained here from a study of song rhythms. Schmidt devotes a section (pp. 114-121) to syllabification and accent. One of the problems is concerned with the presence of closed syllables in Tasmanian words. This syllable structure is interesting in that closed syllables of certain types occur which are not found in Australia, chiefly /ŋt/ which is too well documented to be questioned. Whether a consonant cluster /Cr/ in which C = any consonant is to be accepted cannot be determined. Schmidt did accept it, but on the mainland most investigators now believe that a short vowel is present between the two consonants. The tribal name "Wailbri" is phonemically /'walj'biri/. On this basis krakne 'existed' would be /ka'rakani/. Schmidt has ventured certain ideas on syllable structure, boundaries, juncture, etc., all of which are important, but which must be omitted in the space available here.

As the present phonemicisation differs in some ways from Schmidt's, the spellings of the original sources are here added in brackets after all quoted forms.

* See A. Capell, **A New Approach to Australian Linguistics.** The book is henceforth referred to as NAAL.

SYNTAX

If detailed study of phonetic and phonemic structure is not possible, the grammatical analysis of the language is the next problem that presents itself. Here the case is a little better, though not satisfactory. Schmidt devoted considerable space to it, but most of his verdicts amount to 'not proven'. The chief desideratum at this level of language is text in some form or other, but in Tasmanian any length of running text is conspicuous by its absence. Most of the material is sentence material, disconnected utterances only. In the few instances where a body of connected text is available there is a large measure of doubt as to whether it really represents native Tasmanian utterances or not. One such text is part of a sermon by G. A. Robinson, which is preserved in what appears to be several recensions of the one thing, or perhaps several versions of one theme used on different occasions. One text is given by J. E. Calder in an article on 'Native Tribes of Tasmania' in the Journal of the Anthropological Institute, Vol. 3 (1874), p. 28. Another occurs in the Robinson Diaries under date May 31, 1829 and is presumably preferable as an original. This text is given here (1) as spelled by Robinson, (2) as phonemicised and (3) as translated. Comments then follow. As it was preached to Bruny Island natives it is presumably a South-Eastern dialect.

MOT.TI	NYRAE	PARLERDI	MOTTI	NO.VILLY
moti	nairi	palati	moti	nowili
one	good	God	one	bad

RAEGEWROPPER	PARLERDI	NYRAE
retji-ropa,	palati	nairi
Devil,	God	good

PARLERDI	MAGGERER	WARRANGELLY
palati	makara	waraŋali
God	stop	sky

RAEGEOWROPPER	MAGGERER	TOOGENNER
retji-ropa	makara	tökana
Devil	stop	below

UENEE.	NYRAE	PARLERVAR	LOGERNER
wini.	nairi	palawa	lo:kana
fire.	Good	native	dies

TAGGERER	TEENNY	LAWWAY
takara	tini	lawey
goes	road	up

WARRANGELLY.	PARLERDI	NYRAE
warraŋali.	palati	nairi
sky.	God	good

RAEGE	etc.	etc.
redji	„	„
whiteman		

NOVILLY	PARLERVAR	LOGERNER
nowili	palati	lo:kana
Bad	native	dead

TAGGERER	TEENNY	TOOGUNNER
takara	tini	tökana
go	road	below

RAEGEWROPPER	UENEE	MAGGERER	UENEE.
retji-ropa	wini	makara	wini.
devil	fire	stop	fire.

Schmidt has shown that the normal position of the adjective is after the noun. In this case Robinson's text is 'pidgin' Tasmanian, as the adjectives precede the noun — probably intelligible to his hearers but not grammatically acceptable to them. Moreover, some of the vocabulary is strange: /moti/ is not otherwise attested as a numeral for 'one' Calder's text adds to this:

Palerdee	lowway.	Nyrae	raegae	merrydy
palati	lowei.	nairi	retji	meriti
God	above.	Good	whiteman	sick

nueberrae	Parlerdee	waerangelly.
nüperé	Palati	waraŋali.
looks (to)	God	in-sky.

Kananu	Parlerdee.	Nyrae	Palerdi	nueberrae
ka:nanu	Palati.	Nairi	Palati	nüperé
speaks to	God.	Good	God	sees

nyrae	raegee	timeme	merydy.	Noailly
nairi	retji	timemi	meriti.	nowili
good	whiteman	not	sick	Bad

parleewar	loggernu,	tageere	toogunner.
pa:lawa	lo:kanu,	taki:ri	tu:kana.
native	dies,	below	goes.

Rageowrapper		wenee	maggerer.	Parleewar
Retji	rapa	wini	makara.	pa:lawa
Evil	Spirit	fire-in	stays.	Native

tyrer.	Nyrae	parleewar	maggere.	Parlerdee
taira.	naire	pa:lawa	makara.	Palati
:ries.	Good	native	stays.	God

warangelli	timeme	merrydy,	timeme	taggathe.
waraŋali	timemi	meriti,	timemi	takati.
in-sky	not	sick,	not	hungry.

While there are difficulties about this text, it is quite easy to follow the sequence of ideas intended, and the adaption of phraseology used to help a theologically undeveloped people. A few grammatical possibilities stand out: /kananu/, 'speaks' recalls the text of Genesis, /ka:ni/ (carnee), 'said', and compared with */lo:kanu/* suggests a present tense in -nu corresponding to a past in -i. However, /nüperé/ then seems to follow another pattern. As a matter of fact */nupra/* appears for 'eye', especially in the religious phrase */pöka nüprana/* 'the man's eye' a term used for "the sun".

Apart from these consecutive passages which are certainly Robinson's efforts to speak Tasmanian, and therefore subject to both syntactic and grammatical error, there is little to assist the student. Wilkinson's translation of Genesis I-III remains only in a very small fragment, and even if grammatically correct it is only a very loose paraphrase of a few verses. It is much to be desired that his full translation and the vocabulary said to have existed, should be found again. Ling Roth quotes a passage from an earlier work by Braim, which purports to be a Tasmanian's reflections on the changes befallen his people since the arrival of the white man. This is probably more correct, if true to its presumed origin and not just a reflection by Braim himself cast into a Tasmanian form, and a similar reproduction and analysis of it is added here for what it is worth: some forms are untranslatable, and others again, such as haminen, seem to be so far astray phonetically that they cannot

be recognised now. In the following text the word puti 'not' shows that the dialect is different from Robinson's, which has timemi, and similarly /lapro/ 'see' for Robinson's */nüperé/*. The punctuation is definitely wrong and has here been disregarded.

Mena mulaga laveny powa parmera tara,
mina mulaka laweni puwa pamera tara
I hunt littlo ono wallaby,

lathakar, catabewy, probylathery, pamery
lataka katapewi propilatari pameri
kangaroo, two badger, ono

haminen trairna, pooty lapry, patrola
? t(a)re:na, puti lapri patrola
no see spark

pomely, pooty ribby mena, leprena meena.
pomali puti ripi mina leprene mina
make, no I, house my

Malanthana mena tackay mulaga, pooty
malantana mina také mulaka puti
Childhood I go hunt, not

nara pamery lowgana, lee calaguna, cracky,
nara pameri lo:kana. li kalaküna kraki
it one kangaroo bo

carticata, ludarnny, parobeny, nara moogara
katekato lütani paropeni nara mukara
very bad they "spaniel

nara mena loewgana reethen tratyatetay
nara mina lo:kana riten tratjátete.
dog" my kangaroo
they

tobantheelinga nara laway, rel-bia mena
topanti:liŋa nara lawe relpia mina
it ?up violence me

malathina mobily, worby, pua yunthea.
malatina mapili wo:pi puwa juntia.
whites many little.

One feature that stands out in the various texts, however unsatisfactory in many ways, is the fact that word-order in Tasmanian appears to have possessed a good deal of freedom. Australian languages, especially in the eastern half of the continent, present a similar picture. For example, the relative order in the sentences:

lona tyena pea mito (lona tyennabeah mito)
stone give me-to
noia mia tyaŋ mina nito lina (noia meahteang meena neeto linah)
not I give I you-to water
tyena mia pe tökané (tyennamiape tuggané)
give me food

Sentence types evidenced in the texts are:

1. Equational: 'he is my father' type ('he' = 'my father').

In these there is no equivalent to 'is', no copula verb but simply two nouns (or pronoun and noun) side by side, on the pattern A = B, Topic —> comment, e.g.

ŋana mia numpé (nangameape)
father my he-here —> "he is my father"
riena nara-wá (riena nara-wé)
hand this-(one) —> 'this is (my) hand'.

The comment (B) may be replaced by the assertive particle pea (to be discussed below):

malaŋi pea (he is) a child

Descriptive sentences follow this structural pattern although they are not equational: there is the same convergence of form as in the English types 'the man is a sailor' and 'the man is tall'. Thus lia nowatje (lienowithyé) 'the water (is) salt'; pökana taritje, (puggana taritye) '(he is) a good man'; rauna mɔ.pak '(my) face (is) black'. Sentences of this type coincide syntactically with adjectival phrases, as adjectives follow the noun, noyena nire 'face good'.

The nominal particle -na, to be discussed below under morphology, raises difficulty here. In the example lia nowatje, 'the water (is) salt', there is no liana, whereas in noyena nire 'face good' it is present. More study is needed on this point. It should be remarked however that examples occur in which /takara/ 'stay' is used as "be" /nienta mina takara rutelipana/ 'my sister is very tall' (nienta mena tuggara rooteleebana). The example is open to serious objections and is discussed by Schmidt (p. 336, fn. 1).

2. Sentences of the pattern N + V (noun + verb).

These are numerous, and N may be represented by a pronoun; either N or V may be expanded by adjective or adverb respectively:

lupra-ra lo:kana wi-ni (lueberera logana weenee)
wife-his lying fire-at, 'his wife is lying by the [was] fire'.
palawa makara, timemi takara (palawah maggerer, timeme tuggara)
people stay, not go
lupra* pikata lokana wi-ni, mapili lo:kana wi-ni
wife (and) child dead in-fire, many dead in-fire.
(lueberer pikata lowgana weenee, mobbily lowgana weenee.)
(These sentences are taken from entries in G. A. Robinson's diaries).

3. Sentences of the pattern: V + N, where N is object of V:

1. maŋana traka (mangana trakka)
   throw spear(s)!
2. laieni riakana (laieni riakana)
   sing song
3. tial wi, pella kaieta (teeal wee, peal kaieté)
   take stick, beat-dog

4. Sentences of the pattern V + complement.

The complement may be

(a) a particle preceding, as in
parawe riŋa pe, (parrawe ringape) 'do not run' < riné, 'run', or

(b) an adverbial complement following V, as in
riŋa pea ŋanawepere (ringapyanganaweberé)
run over-the-ground†

* This is the Sydney word, borrowed into Tasmanian.

† Milligan's vocabulary and sentences, from which this sentence is taken, do not allow of the analysis of the final phrase.

5. Sentences of the pattern $N_1 + V + N_2$ (where N_1 is subject and N_2 is object of V, which is then, of course, transitive).

Lowana ole töŋrana* (Lowana ole tubrana)
woman makes basket
women make baskets

In the Genesis translation, verse 1, Godna pomali heavena 'God made the heaven' is clearly based on the same pattern. The suffix -na is discussed below; see also verse 26: mina pomali wiŋa 'I make man'.

If N_1 is a pronoun, three positions are possible:

(i) $(V — N_1) + N_2$ or (ii) $N_1 + V + N_2$ or (iii) $N_2 + (V — N_1)$.

(i) tjana-mia pe panapuna (tyeanna miapé pannaboona)
give I bread

Milligan translates this as 'give me some bread' which seems unlikely; he follows it by two other texts both of which are unanalysable: (1) ti:ŋanána ma panapu (tecngananna me pannaboo (2) taŋunapi pé töŋariŋalia (tunghmbibé tungaringaleah) (phonemicised in the most likely way). All his other examples in $(V — N_1) + N_2$ order he translates as statements, not orders.

(ii) noia mia-tjaŋ nito (noia miatyeang nito)
no I give to you

(iii) lina tjena-mi(a) pea (leena tyeannamiapéa)
water give-I

As already indicated, these types are not mutually exclusive, but freedom of arrangement allows more than one to be used.

Combination of clauses is possible, apparently without conjunction, if the Genesis translation (verse 32) is to be accepted.

Godna lap(a) katia nara pumali
God saw all he made

MORPHOLOGY

On the level of morphology the remains of the Tasmanian language or languages set the student a much harder problem. On the surface the language appears exceedingly — almost excessively — simple. One gets the impression that this simplicity is not only deceptive but wrong, and that the Tasmanian sentences and texts such as G. A. Robinson's sermon are really pidgin Tasmanian, that the authors did not really learn the morphology of the language. It is well known, and Schmidt agrees with other students of the language, that the tense system of the verb appears to be completely absent. Even granted that, like the Baining language of New Britain, Tasmanian verbs may not have been inflected for tense, there is still something missing. A language that could employ relationship suffixes quite liberally to clarify the functions of the noun in the utterance, would very probably provide for the verb also.

* or toγ-prana.

The language shows little complication by way of contrast with the bulk of Australian languages. Fr. Müller picked out a few suffixed morphemes indicating case relationships: -na, subject, -to, indirect object, as illustrated in mi-na, 'I', ni-na, 'you' (sg), naŋga-to 'to the father' and lenu-tu, 'to the house'. Parallel to these there appears to have been a suffixed possessive; illustrated in naŋga-mia, 'my father', which in turn he might have analysed as mi-a, 'me of', but did not, probably because he took it to be identical with the prefix mia- in mia-tjaŋ. 'I give'. However, as a verbal person marker a short form m- appears before initial vowel, as will be shown below.

It may be accepted that Tasmanian nouns appeared in two forms — a stem form and a suffixed form. There is no mention of a locative suffix in Müller's work, but there is the sentence (occurring more than once) in Robinson's diaries, luprara lokana wi-ni, 'his wife is lying' (or in the second example 'is dead') in the fire < wi(na), 'fire'. Schmidt does not mention this suffix but gives -re as the normal locative ending.

Other relationships are indicated by morphemes that are most probably to be written as postpositions, e.g., wi'eta tö kana waratena lunto 'moon goes cloud under', 'the moon has gone behind the cloud'. The test between this treatment and treatment as a simple case ending would be that of phrase stress, which in the present instance cannot be applied, so that the decision between case ending and postposition remains arbitrary. The word lunto looks like a dative form with -to, but there are other forms in the vocabularies, e.g. maŋana luteno (= lotano), 'stand behind the tree', which remain uncertain. Schmidt appears to have regarded these postpositions usually as verbs, giving, for example, 'wana, 'put down, put off' (with bracketed forms 'hernieder(lassen), ab(lassen)').

Special discussion is called for in the case of a certain set of suffixes, and Schmidt is undoubtedly right in regarding these not as morpheme alternants but as regional forms. Whether it is right to speak of a Tasmanian language occurring in five dialectal forms, as Schmidt did, or whether several mutually unintelligible languages are to be recognised, is a debatable point that will be mentioned again later.

Schmidt gives considerable space to the identification of the -na ~ -lia ~ -rika ~ -like ~ -take suffix series, and concludes that (1) they are dialectal variations, (2) they have nothing to do with case, but (3) are noun-markers, (4) which are omitted when the noun is part of a possessive unit, where the formula is $N_1 + N_2 +$ [na]. There is some dialectal variation about point (4). It is impossible here to go into detail on these variations in the present space.

The possessive form is not marked by a case ending but by the omission of the noun marker from the name of the object possessed: löka(na): 'foot' < löka tonye, 'toenail'; peröka niana, 'milk (of woman)'. This is the formula $N_1 + N_2 +$ [na] mentioned above and there are few exceptions to it.

In the N +A (noun-adjective) phrase, the suffix is normally transferred to the adjective: it looks as though such an expression as lowa el-epa-na 'woman beautiful' is being construed as 'woman's beauty'. The -[na] is always phrase-final.

A natural tendency would be to regard these suffixes as subject markers, but the examples surviving are not quite consistent in their use. Calder gives tea noweli, pāmata panmalia, linana noweli (tea noailly, parmatta panmerlia, linener noailly) 'tea no good, potatoes, bread, water no good'. Here tea and pāmata appear without suffixes, panma has -lia, and lina has -na. Wilkinson's Genesis uses -na very consistently in subject position but also in object position: Godna pomali heavena, ko:ntana (Godna pomale heavena, coantana), 'God made heaven (and) earth'. He also uses the noun without suffix: lewara krak(a)ni (lewara crackne), 'darkness existed'. If these variations are really correct, they undoubtedly point to rules of definiteness and indefiniteness that cannot now be recovered, and this may well be the case, but it is equally possible that the translator is in error in at least some instances. The suggestion made here is that the -na group of endings be regarded as 'base' forms, the other endings as 'oblique' case markers. A paradigm could be built up thus:

Root: lenu 'house'
base: lenu-na 'house'
oblique: (1) lenu-to 'to the house'
(2) lenu-ni 'in the house'
(3) lenu-re 'in (? at) the house'.

The root form could be either subject or object; the base form usually subject.

Number does not appear to have been formally indicated in any way, even in pronouns. The forms given for the latter are mi-na, 'I', ni-na, 'you', na-ra, 'he, she', which could be either singular or plural. There is in Norman's vocabulary a listed form waranda, 'we' which does not appear in the sentences, and may be a mistranslation. Norman gives an entry nīggur (=/nika/.), 'it' and this appears in one of the songs sung by Fanny Smith as /nika lükarato pawi/ (nigur lugarato pawe), 'it is springtime'. In Milligan's vocabulary lugarato pawe = 'spring, wattle blossom season', but nigur is not given. This is south-eastern dialect, and if nic.er in Robinson's diaries represents the same word then the phonemic form is /nika/, as in the song recorded under Feb 22, 1834, nika plokāna (nic.er plo.kar.ner), 'it(was) a red horse'.

Possession appears to have been indicated by a series of pronominal suffixes. Following the pattern of the genitive construction mentioned above, a juxtaposition of noun and pronoun would be expected, and there are actually examples of it which do occur, e.g. nunal mina 'father I' in the vocabulary for Oyster Bay and Pittwater tribes. This is rare; far more common is a suffix: naŋa-mia, 'father-my', aŋam lia naŋina? 'where is your father?'. A full paradigm of the system is not preserved but some examples are to hand. Case suffixes are added after the possessive, giving a pattern R + p + c ('root, possessive, case'): tökana lenu-mia-to, '(I) go house-my-to'. It seems that the suffix could be omitted if the context was clear without it: ona pea naŋa-to, 'tell (it) (your) father-to'. At least the surviving examples, though of uncertain quality in many ways, do suggest that this language was rather more complicated than is sometimes stated.

There is no suggestion in any of the material that the Tasmanian verb varied for either person or tense. In this regard it is comparable to the simplest Australian type (Kattang); in fact it is even simpler, for the latter does usually express time differences by means of suffixes. In Tasmanian some of the relevant examples are:

pana manakana (punna mannakanna)
bird(s) sing(s)

noia tjana mi pea wina
not give I — stick (*sc.* to you)

paŋunea rené patili pea
horse runs efficiently —

A number of suffixes to verb stems, however, do appear. The question is how to interpret them. Schmidt's suggestions on the whole seem remarkably unhappy in a language of the type Tasmanian appears to represent, and he is not at all happy with them himself. He interprets them partly on distributional grounds as dialect variations and partly on formal grounds as marking stative (adjectival), infinitive, "ground form" etc. The particle purak after the verb is completive or perfective: miak purak 'dead'; to-me purak, 'sunken'; a phrase rendered "twilight" by Milligan: tekrimani kitana nara loŋ-purak, Schmidt translates as 'twilight small it has become'. The suffixes in question are:

1. -ali(al), -eli, -li, -keli. Schmidt guesses at this as infinitive or imperative, but such double uses are surely incompatible, and the existence of an infinitive in Tasmanian is a priori unlikely. The examples suggest rather a general or aorist force, perhaps just an imperfective with the time largely undetermined.

2. -kana, -kena seems to contrast dialectally with -kara, -kera as SE and S dialects. Schmidt suggests that a verbal noun is intended, which again seems unlikely. His suggestion in the vocabulary 941 (fn. 2) that the word translated 'vassal', piiitökana mina may be 'my tamed one' would mark -kana as participial, but this is not enough evidence. Some other interpretations in the vocabulary are also unsatisfactory: miamengana (/miamaŋana/), 'battle' is clearly 'I throw'; mia lungana 'battle' seems to be /mia löŋana/'I lie down' or 'die'; in another dialect /lo:kana/, 'lie'.

3. -te is certainly, as Schmidt records, a common adjectival ending; it may also be a present, used predicatively with adjectives.

4. -ne 'groundform' is unsatisfactory because it is not clear what a 'groundform' may be. It combines morphophonemically as -ŋ with the completive purak, as in Schmidt's examples (p. 203 but phonemicised here) k(e)raŋpurak 'ripe'; toŋ purak 'sunken'. If the -ne is not present the combinatory form is -k purak, as in tiak purak 'taken' and toyenukpurak 'heard'. The sequence /ŋ - p/ is unexpected as a form of assimilation. There remains the particle pea, pe which has been taken as an imperative marker. Its uses, however, are not limited to modifying a verb; it may occur after a noun, and in fact after both in sequence: noia tjena mi pea wina 'not give I a stick', and also tjena pea kalta pea 'give (to) the dog'. To a student of Papuan languages this recalls the Kiwai (Papuan) particle ai, which serves to 'assert' a state or action or object, and of which S. H. Ray writes :* "This particle asserts the actual performance of an action", and in Kiwai : "It takes precedence of all other verbal particles and is written prefixed to the personal or tense sign."

The wide variety of sentence types which exhibit the Tasmanian particle pea or pe make it most unlikely that this was a verbal particle of any kind. The following examples will illustrate this variety, and show that its occurrence with imperatives is only one of a number of uses :

ona pea (or una pea), 'tell him';
malaŋi pea 'the child is small' (more probably 'it is a child')
rien tona pea 'touch (his) hand'
tyana mia pe panapuna 'give me bread'
parapitali pea malana talia waraŋaté '(I) make the boat go fast'.
paŋunia rene pateli pea 'the horse runs strongly'.

Many of the combinations given in the sources as sentences seem to be merely phrases; either part of the utterance has been missed or the whole (if complete) has been mistranslated. The verbal system, even allowing for dialect variation, was evidently more complicated than the interpreters have taken it to be. In the case of the verb ta- 'to go', the following derivatives are found: ta-kana, ta-kara, ta-karako, ta-le, ta-lia, ta-we. It is difficult to suggest meanings for any of these. ta-karako is rendered 'I must go, I shall go'; tale parawe, 'don't go away'; tal pea watero, 'come here', tale lenu-to, 'go house-to', mi takara marawamina, 'I go me I', i.e. 'I am going alone'; ta-we rante wepöre, 'go run ground-on'. Many of these renderings are unsatisfactory. They mostly seem to be imperatives, which is unlikely. Moreover, there seem to be some morphophonemic changes not recognised even by Schmidt: in the last example, rante belongs to a form more usually found as rene, 'run'. If ta-le is to be taken as imperative, rante = ran/ren + le 'run', also is imperative. Yet nothing remains but to note these changes as possible explanations of irregularities. The form mitakara 'I walk' seems to be present or at best aorist, and to show a short pronoun, mi (root of mi-na 'I') preposed. The sentence

para petali pea mala-na ta-lia waraŋate
away forcefully (emph.) the boat goes quickly
shows a present progressive, if ta-lia means 'is going'.

Then also

wita ta-kana waratena linta
moon gone cloud under

would suggest a perfective or stative past meaning for -kana. These are some of the reasons for Schmidt's hesitance about assigning meanings to verb endings. The form ta-kara-ko 'I must/will go' stands alone, without context and without parallel so that nothing can be deduced from it.

The answer to the question which heads this paper is thus shown to be not quite "nothing", but only "very little", and that little contains many uncertainties, which it seems quite unlikely that time will resolve. Moreover, the situation is complicated by the question of dialectal divisions. In spite of the smallness of the aboriginal population, there seems to have been very little linguistic unity among them. Whether "dialect" is the right term to indicate the variations found in the sources, it is difficult to say; quite possibly the term "languages" is justified. A lexicostatistic estimate of the divergencies between the vocabularies may show that the boundary of "dialect" is transcended. The test of mutual intelligibility cannot be applied in the absence of speakers. Schmidt estimates five dialects; others have favoured the recognition of at least eastern and western languages, and to the present writer, judging without statistical examination, this seems a very reasonable viewpoint. In this regard also a previously rather unsatisfactory answer to the question posed becomes no more satisfactory. Possibly with more detailed examination it might do so, but this remains still for the future.

* S. H. Ray. A grammar of the Kiwai language, Fly Delta, Papua, Port Moresby, N.D., p. 43.

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